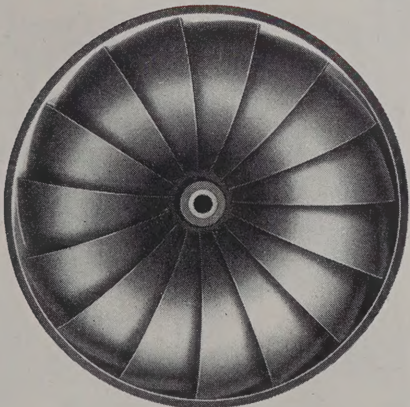
LEFFEL

IMPROVED VERTICAL SAMSON TURBINES

BULLETIN 38



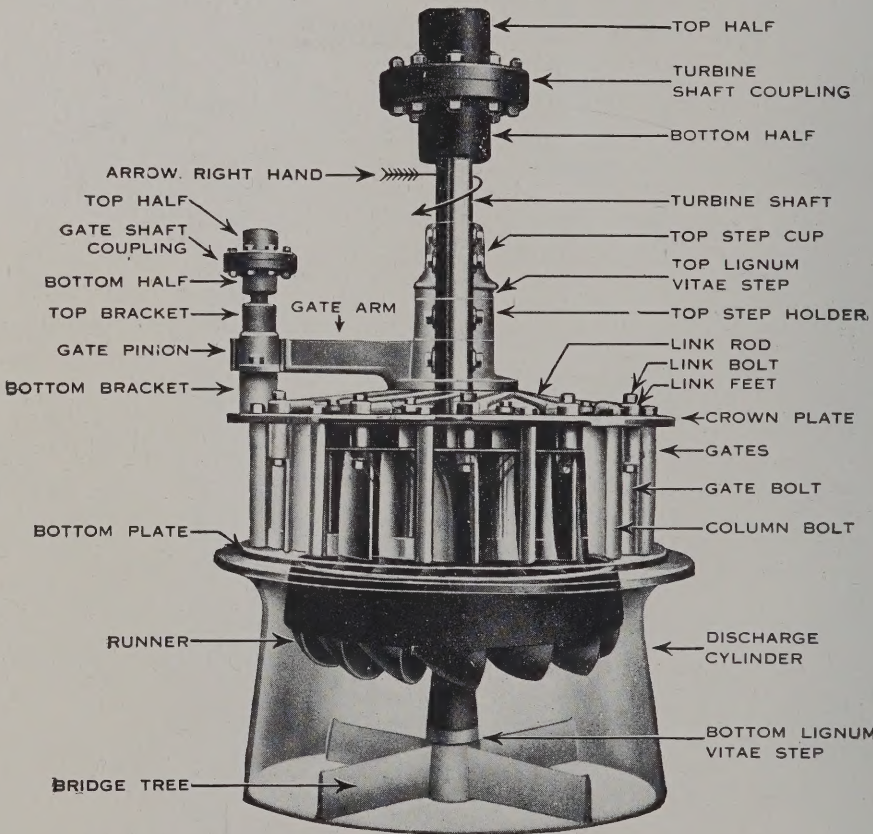
THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO, U. S. A.

ESTABLISHED 1862

Improved Vertical Samson Turbines

These turbines are built strong and substantial, and equipped with our exclusive design double steel bucket runners fitted on steel shafts. Large top and bottom lignumvitae step bearings for carrying the revolving parts of these turbines, including the weight of extra upright shafting and gearing. Also, balanced swing-type gates with separate adjustable steel connections. Each gate removable independently. All bearings of large dimensions and special material. Bolted couplings.



The above illustration shows the design and construction of our Improved Vertical SAMSON Turbines and gives the names of each of the various parts.

The arrow on Turbine Shaft shows Right Hand Rotation.

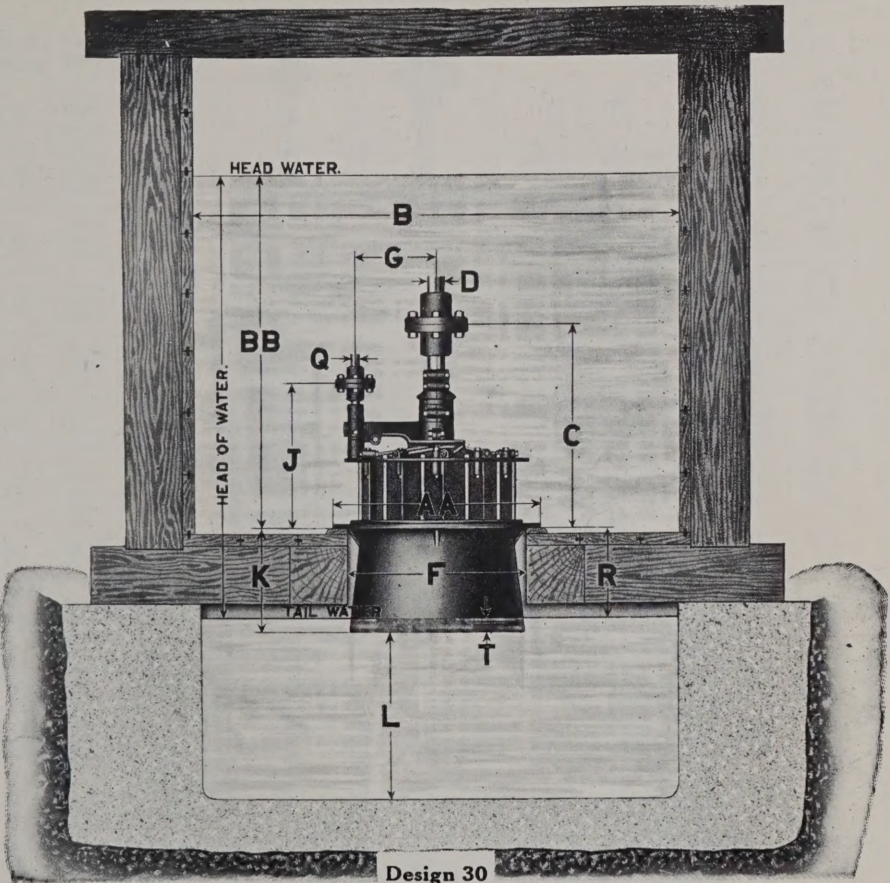
We bore and keyseat the top halves of Couplings to suit your requirements.

For dimensions of SAMSON Turbines in Open Flume Setting, see Page 3.

For dimensions of Steel Flumes for SAMSON Turbines, see Page 4.

For Power and Speed of Improved Vertical SAMSON Turbines, see Pages 5 and 6.

Improved Dimensions of Vertical Samson Turbines

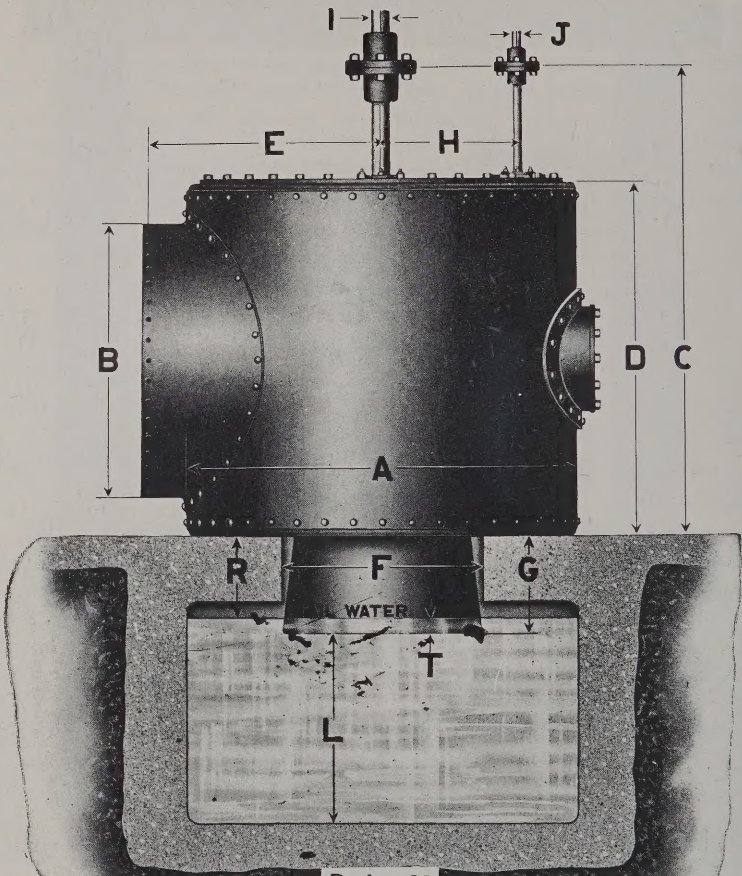


Design 30

SIZE OF SAMSON TURBINES ☛		17E	17D	17C	17B	17A	20	23	26	30	35	40	45	50	56	62	68	74
AA	Cylinder Flange Diameter...	33	33	33	33	33	36	40	44	49	56	63	70	76	86	94	102	110
B	Penstock Width not less than	48	48	48	48	48	60	72	84	96	108	120	132	144	156	168	180	192
BB	Water Depth not less than ..	42	42	42	42	42	48	54	60	66	72	78	84	90	96	102	108	114
C	Turbine Shaft Height.......	32	32	32	32	32	35	40	45	50	55	60	65	70	75	80	85	90
D	Turbine Coupling Bore	2 1/8	2 3/8	2 3/8	2 5/8	2 5/8	2 7/8	3 1/8	3 3/8	3 7/8	4 3/8	4 7/8	5 3/8	5 7/8	6 3/8	6 7/8	7 3/8	7 7/8
F	Diameter Hole in Floor.....	28	28	28	28	28	31	35	39	44	51	57	64	70	78	86	94	102
G	Between Shaft Centers	12	12	12	12	12	14	16	18	20	22	25	28	31	34	38	42	46
J	Gate Shaft Height	23	23	23	23	23	25	27	29	32	35	38	42	46	50	54	59	64
K	Discharge Cylinder Length..	15	15	15	15	15	17	19	21	24	27	30	33	36	40	44	48	52
L	Discharge Depth not less than	27	27	27	27	27	30	36	42	48	54	60	66	72	84	96	108	120
Q	Gate Coupling Bore........	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 7/16	1 7/16	1 11/16	1 11/16	1 15/16	1 15/16	2 3/16	2 3/16	2 7/16	2 7/16	2 11/16	2 11/16
T	Submergence not less than ..	3	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6

All dimensions in the above table are given in INCHES.
Power tables of these vertical SAMSON turbines on pages 5 aud 6 inclusive.
We also build these SAMSON turbines various horizontal designs as required.
Dimensions of STEEL FLUMES for these vertical SAMSON turbines on page 4.

Dimensions of Steel Flumes For Improved Vertical Samson Turbines



Design 33

	SIZE OF SAMSON TURBINES ☞	17E	17D	17C	17B	17A	20	23	26	30	35	40	45	50	56
A	Diameter of Steel Flume	54	54	54	54	54	60	66	72	84	96	108	120	132	144
B	Inside Diameter of Feeder Pipe	24	26	28	30	36	42	48	54	60	72	84	96	108	120
C	Height of Turbine and Gate Shafts	54	56	58	60	66	72	78	84	90	102	114	132	144	156
D	Height of Steel Flume	36	38	40	42	48	54	60	66	72	84	96	108	120	132
E	Center Turbine Shaft to Center of Rivet Holes	33	33	33	33	33	36	39	42	48	54	60	66	72	78
F	Size of Hole to Clear Discharge Cylinder	28	28	28	28	28	31	35	39	44	51	57	64	70	78
G	Length of Discharge Cylinder under Flume	12	12	12	12	12	13	15	17	19	22	25	28	31	34
H	Distance Between Centers of Shafts	12	12	12	12	12	14	16	18	20	22	25	28	31	34
I	Diameter of Bore in Turbine Shaft Coupling	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{3}{8}$	$2\frac{5}{8}$	$2\frac{5}{8}$	$2\frac{7}{8}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{7}{8}$	$4\frac{3}{8}$	$4\frac{7}{8}$	$5\frac{3}{8}$	$5\frac{7}{8}$	$6\frac{3}{8}$
J	Diameter of Bore in Gate Shaft Coupling	$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{3}{16}$	$1\frac{7}{16}$	$1\frac{7}{16}$	$1\frac{11}{16}$	$1\frac{11}{16}$	$1\frac{15}{16}$	$1\frac{15}{16}$	$2\frac{3}{16}$	$2\frac{3}{16}$	$2\frac{7}{16}$
L	Depth under Disch. Cylinder not less than	27	27	27	27	27	30	36	42	48	54	60	66	72	84
T	Submergence of Disch. Cylinder not less than	3	3	3	3	3	4	4	4	4	5	5	5	5	6

All dimensions in the above table are given in INCHES.
These STEEL FLUMES larger than 10 feet diameter made in sections, riveted together when placing to position. Top and bottom heads cast iron.
We build all sizes vertical and horizontal steel flumes, pipes and draft tubes.

Power Table — Improved Vertical Samson Turbines

Size of Turbine	Head	3	4	5	6	7	8	9	10	11	12	13	14
17 E.	Power	1.1	1.7	2.5	3.2	4.1	5.0	6.0	7.0	8.1	9.2	10.4	11.7
	Water	252	291	325	356	384	411	436	460	182	503	524	544
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 D.	Power	1.5	2.3	3.2	4.3	5.4	6.5	7.8	9.2	10.6	12.0	13.6	15.2
	Water	328	379	423	464	502	536	569	601	629	657	683	709
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 C.	Power	2.0	3.0	4.3	5.6	7.1	8.6	10.3	12.1	14.0	15.8	17.9	19.0
	Water	433	499	558	611	650	706	749	791	828	864	900	934
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 B.	Power	2.4	3.7	5.3	7.0	8.7	10.6	12.7	14.9	17.2	19.5	22.0	24.7
	Water	533	616	689	754	815	871	924	975	1021	1066	1110	1153
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
17 A.	Power	3.2	4.9	6.9	9.1	11.4	13.9	16.6	19.5	22.5	25.5	28.8	32.3
	Water	697	805	900	986	1065	1139	1208	1275	1335	1394	1451	1506
	Speed	161	186	208	228	246	264	280	294	308	322	335	348
20.	Power	4.2	6.4	9.0	11.9	15.0	18.3	21.8	25.5	29.5	33.6	37.8	42.3
	Water	914	1055	1180	1293	1396	1493	1583	1669	1750	1828	1903	1975
	Speed	140	162	182	199	215	230	244	257	270	282	293	304
23.	Power	5.5	8.5	11.9	15.7	19.8	24.2	28.8	33.8	39.0	44.4	50.0	55.9
	Water	1209	1391	1561	1710	1847	1974	2094	2207	2315	2418	2517	2612
	Speed	127	141	158	173	187	200	211	224	235	245	255	265
26.	Power	7.10	10.9	15.2	20.1	25.3	30.9	36.8	43.2	49.8	56.7	64.0	71.5
	Water	1545	1784	1995	2185	2360	2523	2676	2821	2959	3090	3216	3338
	Speed	108	125	140	153	166	177	188	198	207	217	226	234
30.	Power	9.44	14.5	20.3	26.7	33.6	41.1	49.1	57.5	66.3	75.5	85.2	95.2
	Water	2057	2375	2656	2909	3142	3359	3563	3756	3939	4114	4282	4444
	Speed	94	108	121	132	143	153	163	171	180	188	195	203
35.	Power	12.8	19.7	27.5	36.2	45.6	55.7	66.5	77.9	89.8	102.0	115.0	129.0
	Water	2789	3220	3600	3944	4260	4554	4830	5091	5339	5577	5805	6024
	Speed	81	93	104	114	123	132	140	147	154	161	168	174
40.	Power	16.8	25.8	36.1	47.5	59.8	73.1	87.2	102.0	118.0	134.0	151.0	169.0
	Water	3657	4223	4722	5172	5587	5972	6335	6677	7003	7315	7613	7900
	Speed	70	81	91	100	108	115	122	129	135	141	147	152
45.	Power	21.2	32.7	45.7	60.1	75.7	92.5	110.0	129.0	149.0	170.0	192.0	214.0
	Water	4629	5344	5975	6546	7070	7558	8017	8450	8861	9257	9635	9999
	Speed	63	72	81	88	96	102	109	114	120	125	130	135
50.	Power	26.2	40.5	56.4	74.2	93.5	114.0	136.0	160.0	184.0	210.0	235.0	264.0
	Water	5714	6598	7377	8081	8729	9331	9897	10433	10942	11429	11795	12344
	Speed	56	65	73	80	86	92	98	103	108	113	117	122
56.	Power	32.9	50.6	70.8	93.0	117.0	143.0	171.0	200.0	231.0	263.0	297.0	332.0
	Water	7168	8277	9254	10137	10950	11705	12415	13087	13726	14336	14922	15485
	Speed	50	58	65	71	77	82	87	92	96	101	105	109
62.	Power	40.3	62.1	86.8	114.0	144.0	176.0	210.0	245.0	283.0	323.0	364.0	407.0
	Water	8787	10146	11344	12426	13419	14349	15219	16042	16825	17574	18291	18982
	Speed	45	52	59	64	69	74	79	83	87	91	95	98
68.	Power	48.5	74.7	104.0	137.0	171.0	211.0	252.0	295.0	341.0	388.0	438.0	489.0
	Water	10570	12204	13645	14947	16145	17258	18306	19297	20238	21139	22002	22832
	Speed	41	48	53	59	63	68	72	76	79	83	86	89
74.	Power	57.5	88.5	124.0	162.0	205.0	250.0	299.0	350.0	403.0	460.0	518.0	579.0
	Water	12517	14453	16159	17701	19120	20439	21679	22852	23967	25034	26056	27039
	Speed	38	44	49	54	58	62	66	70	73	76	79	82

EXPLANATION OF ABOVE TABLES

HEAD = Effective head in feet. WATER = Cubic feet discharged per minute. POWER = Full gate horsepower. SPEED = Number of revolutions per minute. We also build IMPROVED SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table. These IMPROVED VERTICAL SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 3.

Power Tables Continued on page 6.

Power Table – Improved Vertical Samson Turbines

Size of Turbine	Head ☛	15	16	17	18	19	20	21	22	23	24	25	26
17 E.	Power	12.9	14.3	15.6	17.0	18.4	19.9	21.4	22.9	24.5	26.2	27.8	29.5
	Water	553	581	599	617	634	650	666	682	697	712	727	741
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 D.	Power	16.9	18.6	20.4	22.1	24.0	25.9	27.9	29.9	32.0	34.1	36.2	38.5
	Water	734	758	782	804	827	848	869	889	909	929	948	967
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 C.	Power	22.2	24.5	26.8	29.1	31.6	34.1	36.8	39.4	42.2	45.0	47.7	50.7
	Water	967	998	1029	1059	1088	1116	1144	1171	1197	1223	1248	1273
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 B.	Power	27.4	30.2	33.1	36.0	39.0	42.1	45.4	48.6	52.0	55.5	58.9	62.6
	Water	1193	1232	1270	1307	1343	1377	1411	1444	1476	1509	1540	1571
	Speed	360	373	384	394	405	416	426	436	446	454	464	474
17 A.	Power	35.6	39.5	43.3	47.0	51.0	55.0	59.3	63.5	68.0	72.5	77.0	81.8
	Water	1559	1610	1660	1708	1755	1800	1845	1888	1930	1972	2013	2053
	Speed	360	373	384	394	406	416	426	436	446	454	464	474
20.	Power	46.9	51.5	56.6	61.7	66.9	72.2	77.7	83.3	89.0	94.9	101.0	107.0
	Water	2044	2111	2179	2239	2300	2360	2419	2476	2531	2586	2639	2691
	Speed	315	325	335	345	354	364	373	381	390	398	407	415
23.	Power	62.0	68.3	74.9	81.6	88.5	95.5	103.0	110.0	118.0	126.0	133.0	141.0
	Water	2703	2792	2878	2961	3043	3122	3199	3274	3348	3420	3489	3559
	Speed	274	283	292	300	308	316	324	332	339	346	354	361
26.	Power	79.3	87.3	95.7	104.0	113.0	121.0	131.0	141.0	151.0	160.0	171.0	180.0
	Water	3455	3569	3678	3785	3888	3919	4088	4181	4278	4370	4460	4549
	Speed	242	250	258	265	273	280	287	293	300	306	313	319
30.	Power	106.0	116.0	127.0	139.0	150.0	162.0	175.0	188.0	200.0	214.0	227.0	241.0
	Water	4600	4751	4897	5039	5177	5312	5443	5571	5696	5818	5938	6056
	Speed	210	217	224	230	236	242	248	254	260	265	271	276
35.	Power	143.0	158.0	173.0	188.0	204.0	220.0	237.0	254.0	272.0	290.0	308.0	327.0
	Water	6236	6440	6638	6831	7018	7200	7378	7552	7721	7887	8050	8210
	Speed	180	186	192	197	203	208	213	218	223	227	232	237
40.	Power	188.0	207.0	226.0	247.0	268.0	289.0	311.0	333.0	356.0	380.0	404.0	428.0
	Water	8178	8446	8706	8958	9204	9443	9676	9904	10126	10344	10558	10767
	Speed	157	163	168	172	177	182	186	191	195	199	203	207
45.	Power	238.0	262.0	287.0	312.0	336.0	366.0	393.0	422.0	451.0	481.0	511.0	542.0
	Water	10350	10689	11018	11337	11648	11951	12246	12534	12816	13091	13361	13626
	Speed	140	145	149	153	158	162	166	170	173	177	181	184
50.	Power	293.0	324.0	354.0	385.0	418.0	451.0	486.0	521.0	557.0	593.0	631.0	669.0
	Water	12777	13196	13603	13997	14380	14754	15118	15474	15822	16162	16496	16822
	Speed	126	130	134	138	142	145	149	153	156	159	162	166
56.	Power	368.0	405.0	444.0	484.0	524.0	566.0	609.0	653.0	699.0	744.0	791.0	839.0
	Water	16028	16554	17063	17558	18039	18508	18965	19411	19847	20274	20692	21102
	Speed	112	116	120	123	127	130	133	136	139	142	145	148
62.	Power	451.0	497.0	544.0	593.0	643.0	694.0	747.0	801.0	856.0	913.0	970.0	1030.0
	Water	19648	20292	20917	21523	22113	22688	23248	23795	24329	24853	25365	25868
	Speed	102	105	108	111	114	117	120	123	126	128	131	134
68.	Power	542.0	597.0	654.0	713.0	773.0	835.0	898.0	963.0	1030.0	1098.0	1167.0	1238.0
	Water	23634	24409	25160	25890	26599	27290	27964	28622	29265	29895	30511	31115
	Speed	93	96	99	101	104	107	109	112	115	117	120	122
74.	Power	642.0	708.0	775.0	844.0	916.0	992.0	1064.0	1141.0	1220.0	1296.0	1382.0	1466.0
	Water	27988	28906	29796	30659	31500	32318	33116	33895	34657	35403	36132	36848
	Speed	85	88	91	94	96	99	101	103	106	108	110	112

EXPLANATION OF ABOVE TABLES

HEAD = Effective head in feet. WATER = Cubic feet discharged per minute.
POWER = Full gate horsepower. SPEED = Number of revolutions per minute.
We also build IMPROVED SAMSON turbines developing power and speed values HALF WAY between each of the different sizes of turbines given in above table.

These IMPROVED VERTICAL SAMSON turbines to develop above power, speed and efficiency values, must be installed and operated substantially as given on page 3.

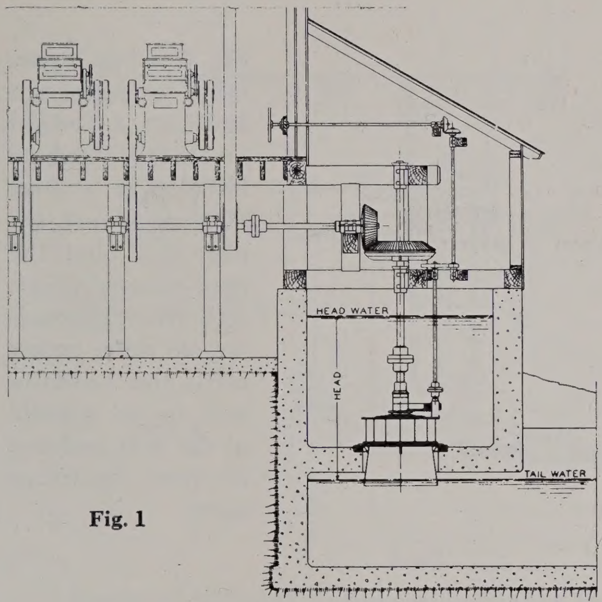


Fig. 1

Fig. 1 shows a Vertical SAMSON Turbine in an open flume, driving the main line shaft of a Flour Mill through Bevel Mortise Gears. This is an arrangement commonly used under low heads of water.

Improved SAMSON Turbine Driving Flour Mill

Fig. 2 shows a typical arrangement for driving a Feed Mill with a Vertical SAMSON Turbine under a low head of water. Many variations of this drive may be used in connection with Mill and other machinery.

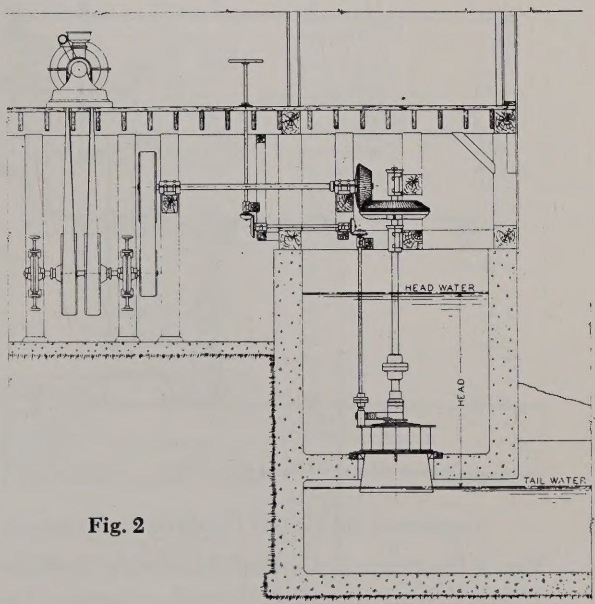


Fig. 2

Improved SAMSON Turbine Driving Feed Mill

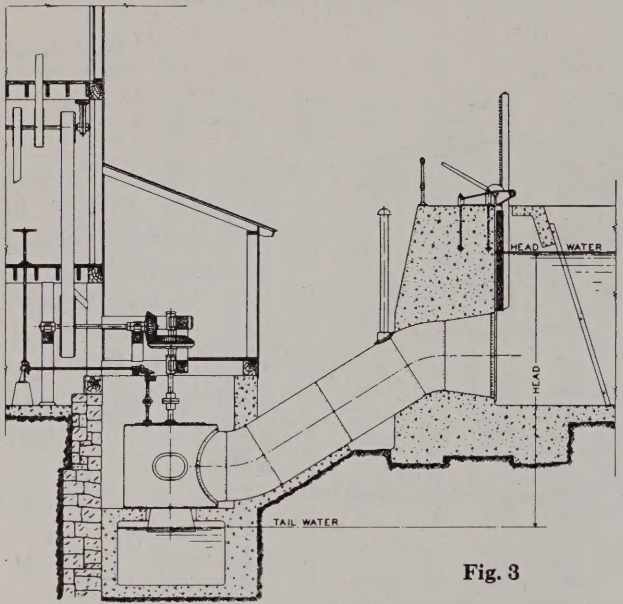


Fig. 3. When higher heads of water are available, a Vertical SAMSON Turbine installed in a Steel Pressure Flume (see page 4) is often the most economical setting. When remodeling old water power mills the Turbine may be set outside of the mill building to save building costs.

Fig. 3

Improved SAMSON Turbine in Steel Pressure Flume

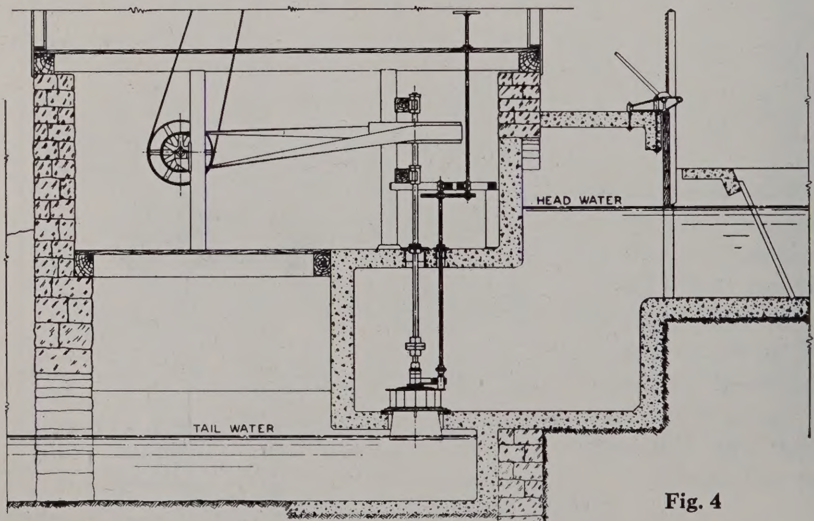


Fig. 4

Improved SAMSON Turbine in Concrete Pressure Flume

Fig. 4 illustrates a Vertical SAMSON Turbine in Concrete Pressure Flume driving line shaft through a Quarter Turn Belt. In some cases concrete construction is more convenient to use, especially where the reinforcement of old foundations and walls is desired.

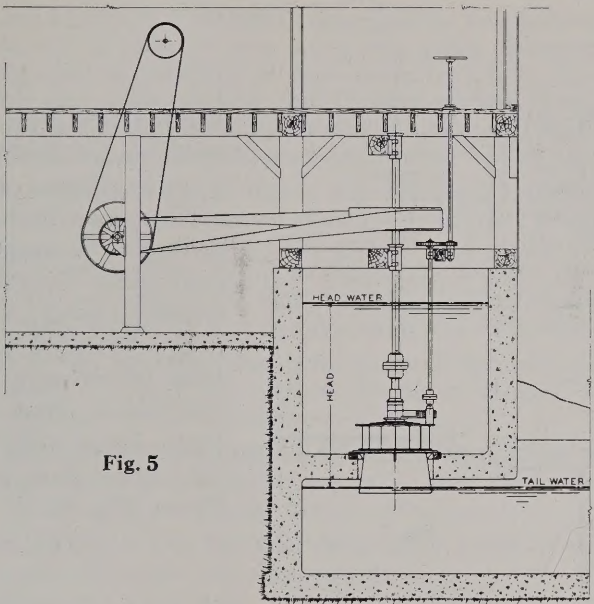


Fig. 5

Fig. 5. The relatively high speed of the Improved SAMSON Turbine under low heads of water frequently permits the use of a Quarter Turn Belt Drive, as a minimum diameter of driving pulley is required. This type of drive is quiet and efficient.

Improved SAMSON Turbine with Quarter Turn Belt Drive to Mill Line Shaft

Fig. 6 shows a Vertical SAMSON Turbine in Open Flume driving a high speed, horizontal Electric Generator through Quarter Turn Belt. A SAMSON Turbine may be used with or without a Governor.

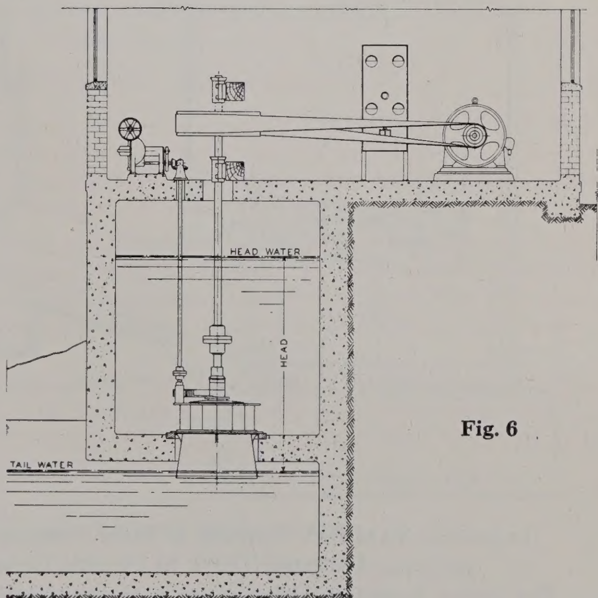


Fig. 6

Improved SAMSON Turbine with Quarter Turn Belt Drive to Electric Generator

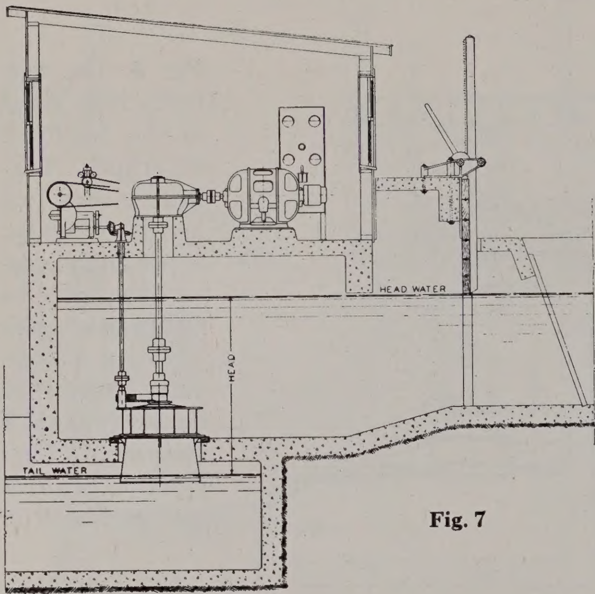


Fig. 7

Figures 7 and 8 shown on this page illustrate a very efficient and modern method of driving a horizontal, high speed Electric Generator using a Vertical SAMSON Turbine which may be installed in either an Open Flume (Fig. 7) or a Steel Pressure Flume (Fig. 8).

Improved SAMSON Turbine in Open Flume with Speed Increaser Drive to Electric Generator

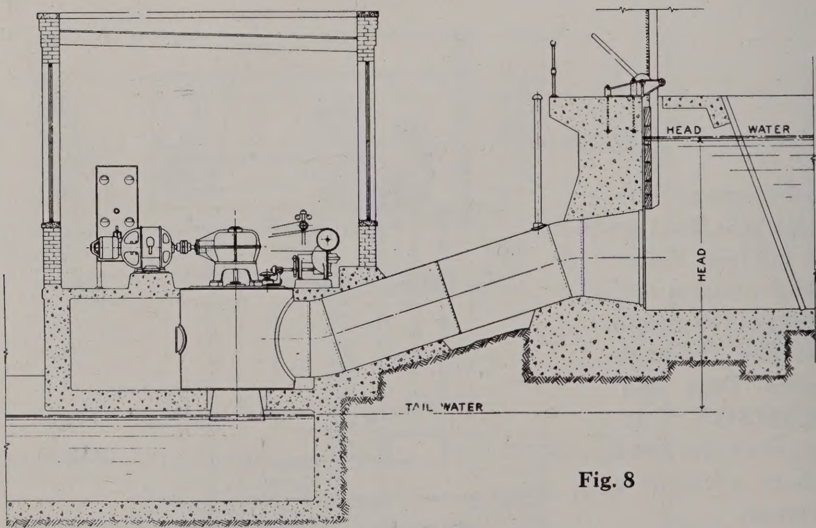


Fig. 8

Improved SAMSON Turbine in Steel Pressure Flume with Speed Increaser Drive to Electric Generator

The Speed Increaser Drive consists of accurately machined steel gears encased in a metal housing filled with oil. These gears are of the correct proportion to step up the Turbine speed to the high speed of the Generator. This makes a very quiet, compact and efficient arrangement. Further particulars will be furnished on request.

Our SAMSON TURBINE, described in this Bulletin (Pages 1 to 10, inclusive), is a product of over ninety-two years of continuous experience in the design and manufacture of high grade, hydraulic equipment. Many improvements have been made in this Turbine without changing overall dimensions or operating speed, and it is today the most POWERFUL and EFFICIENT TURBINE especially adapted for driving factory and mill equipment.

In addition to the foregoing examples of SAMSON TURBINE installation many other arrangements may be used, utilizing horizontal as well as vertical settings. Our Engineering Department will gladly assist and advise you regarding any details relating to the installation of LEFFEL Turbines. In order that you may realize the most from this service please give us **all possible information** with your first inquiry, using the following as a guide:

HEAD OF WATER: This is the vertical distance from Head Water surface down to Tail Water surface. The term "HEAD" is graphically illustrated on Figures 1 to 8, inclusive.

QUANTITY OF WATER AVAILABLE: If possible give minimum and average stream flow in cubic feet per minute. See pages 14 and 15 for instructions for measuring the flow of streams.

MACHINERY TO BE DRIVEN: State kinds of machinery to be driven, pulley sizes and line shaft speeds.

PRESENT TURBINES: State make and size of present turbines; this is always helpful in the selection of new equipment. Send drawings, sketches or photos of present conditions.

PIPE LINE: If present Pipe Line or Feeder Pipe is to be used state length and diameter. If it is to be new, state length required.

IMPORTANT – Please Note!

We ALSO design and manufacture a complete line of Vertical and Horizontal Turbines of various capacities and speeds for driving Electric Generators, Pumps, Paper Mills, Textile Mills and many other kinds of heavy duty machinery. A few of these Designs are illustrated on Pages 12 and 13.

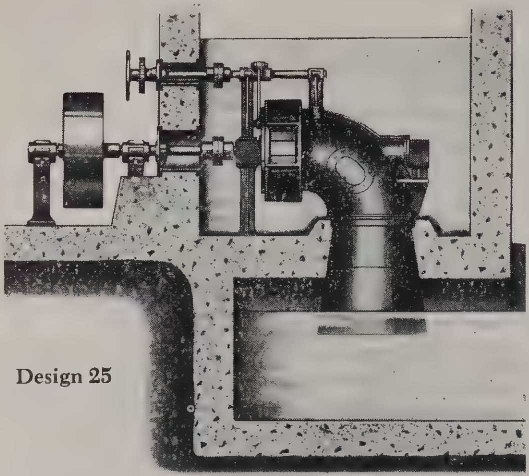
Our staff of designers, with a background of Company experience extending over more than three-quarters of a Century, have produced Hydraulic Turbines, tested by disinterested Engineers, that Established World's Record EFFICIENCIES in the Holyoke Testing Flume, in our Testing Laboratory, and in the field.

SEND FOR OUR LATEST BULLETINS AND INFORMATION CONCERNING HUNDREDS OF DESIGNS, TYPES AND CAPACITIES OF TURBINES MANUFACTURED BY US TO MEET YOUR SPECIFIC CONDITIONS AND REQUIREMENTS.

We also manufacture and are prepared to quote on:

Pipe Lines,
Penstocks,
Draft Tubes,
Manholes,
Head Gate Hoists,
Head Gates,
Trash Racks,
Drain Valves.

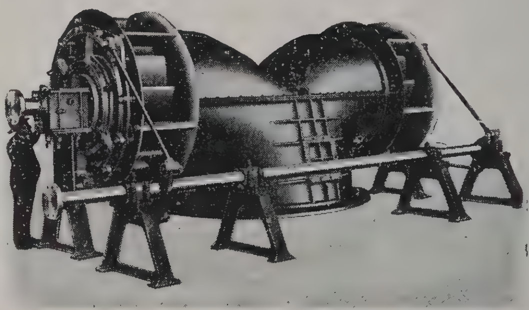
ALL OUR TURBINES ARE FULLY GUARANTEED



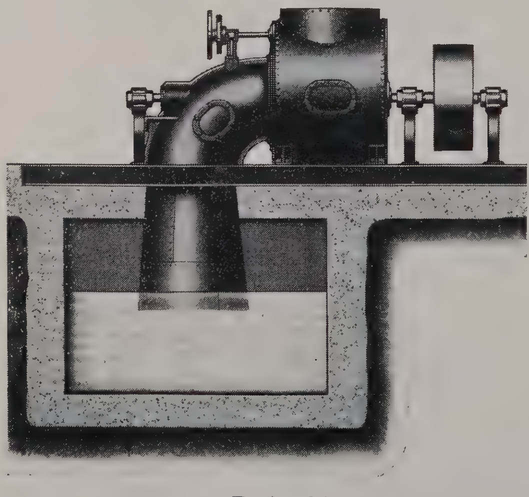
Design 25

Design 25 shows a Single Runner Horizontal Turbine in an Open Flume, arranged for belt drive. LEFFEL turbines of this Design can be furnished with coupling for direct connection, or a V Belt Drive may be used if desired. Numerous LEFFEL Designs, other than shown herein, are available to meet special requirements of head and capacity.

Design 22 indicates a Double Runner, Center Discharge, Horizontal Turbine designed for heavy duty. Turbines similar to this may be installed in Open Flumes or in Horizontal Steel Plate Pressure Cases. This Twin Runner design permits high speed with great capacity. Frequently pairs of Turbines of this type are connected in tandem for still greater capacity.

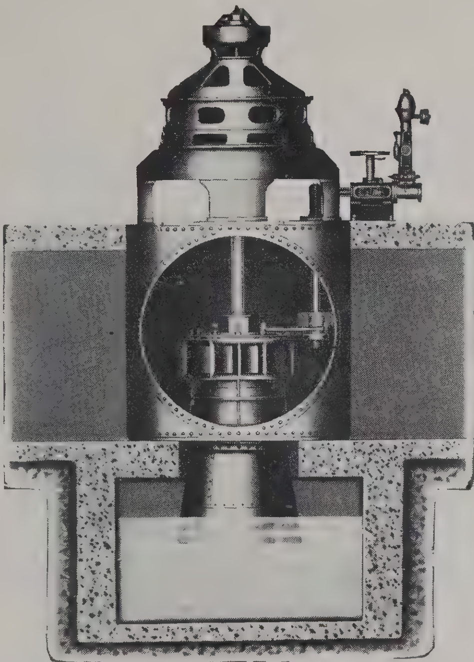


Design 22



Design 24

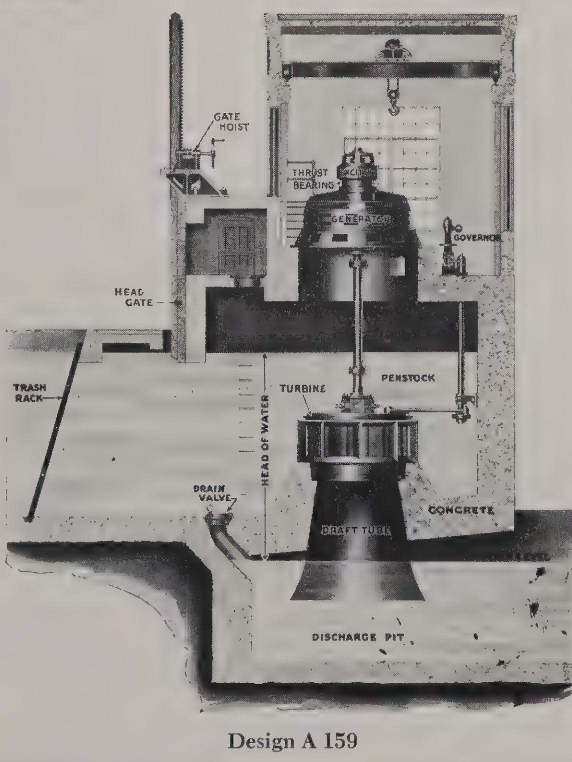
Design 24 illustrates a Single Discharge Horizontal Turbine similar to Design 25 except that it is installed in a Steel Plate Pressure Case suitable for higher heads of water. Many other forms of this same design are available. We **also** specialize in the design and manufacture of Horizontal and Vertical Scroll Case Turbines of various capacities and speeds. YOUR SPECIFICATIONS WILL RECEIVE OUR PROMPT ATTENTION.



Design 156

Design 156 shows a Vertical LEFFEL Turbine in a Steel Pressure Flume and direct connected to a Vertical Electric Generator which is mounted on top of the Flume. This makes a complete self contained unit, very economical as to field construction and erection costs. It may be used under low heads of water where present conditions do not permit of an economical open Flume installation and it is also admirably suited to the higher head developments involving Pipe Lines. LEFFEL Turbines of all types may be used in this Design.

Design A159, shown at the right, illustrates a complete typical Open Flume setting for a LEFFEL Vertical Turbine direct connect to Vertical Electric Generator. This type of setting is particularly adapted to the lower Heads of Water and, when ample water passages are provided, highest Efficiency is possible. WE ALSO FURNISH MANY other designs of Vertical Turbines suitable for high or low heads of water and for installation in cast iron, steel or concrete Scroll Cases. WRITE FOR FURTHER PARTICULARS.



Design A 159

Different Methods With Instructions For Measuring Water

Measuring Flow of Water by Weir Method

After deciding upon suitable location for the new power plant, the following preliminary measurements must be obtained:

FIRST, obtain in feet the head of water This is the vertical distance from the surface of water above dam down to the tail water surface below dam at the place where turbines will be located.

SECOND, obtain minute cubic feet of water. Several methods may be used, the easiest and most commonly used methods are as follows:

If the stream is large, select place where water flows slowly for some distance between parallel banks and where the bottom of stream is fairly even. Then carefully space and measure the cross sectional area of water in square feet. Then place a float that sinks well down into the water in the center of stream and accurately measure the distance in feet the float travels in one minute. Then multiply this distance by the cross sectional square feet area, and eighty-three per cent of this result will be approximately the minute cubic feet of water flowing in the stream. Or,

If the stream is small the water can be measured by weir. (See the above illustration.) Select first a suitable location in stream where water flows slowly, then place a board with notch in same, forming a weir dam; the down stream edge of weir notch beveled almost to a sharp edge; the width B must be about six times the greatest depth of water flowing over weir. The bottom edge of weir not less than one foot above

Table Giving Minute Cubic Feet of Water 1 Inch Wide Flowing Over Weir

Inches Depth C Over Stake		1/8 Inch	1/4 Inch	3/8 Inch	1/2 Inch	5/8 Inch	3/4 Inch	7/8 Inch
1 Inch	.40	.47	.55	.65	.74	.83	.93	1.03
2 "	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3 "	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4 "	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5 "	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6 "	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7 "	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8 "	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9 "	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10 "	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11 "	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12 "	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13 "	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14 "	21.09	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15 "	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16 "	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17 "	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18 "	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19 "	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20 "	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21 "	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22 "	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23 "	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24 "	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

the surface of water below the down-stream side of weir. Then drive a stake up stream several feet above weir. The top of stake must be exactly level with bottom edge of weir. When all water is flowing over weir, measure the depth C over top of stake, then read above weir table which gives the minute cubic feet of water 1 inch wide flowing over weir. Example: Assume width B of weir as 70 inches, depth C as 12½ inches. Look down the first column in weir table to 12 inches, then horizontally to column under ½ inch. The minute cubic feet flowing over weir 1 inch wide, 12½ inches deep will be 17.78 multiplied by 70 inches, the result is 1244.60 minute cubic feet flowing over weir.

The horsepower of the minute cubic feet of water thus obtained for any head up to 50 feet given in power tables, pages 10 to 13, inclusive.

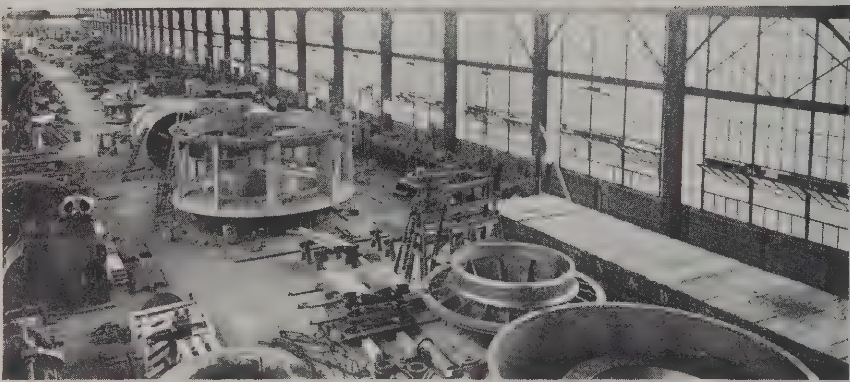
If water is measured by miner's inch method, give us the number of miner's inches of water per minute, together with the head of water. We then will advise the horsepower that can be developed by our turbines.

Send us full measurements and particulars regarding proposed new turbine installment. We will reply promptly with full information.

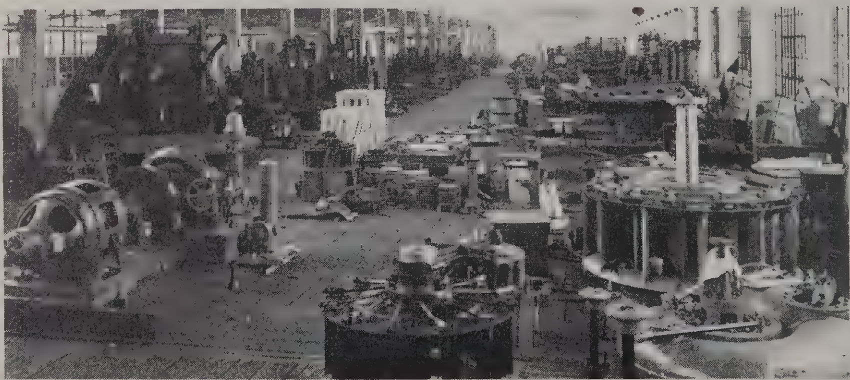
THE JAMES LEFFEL & CO.

ESTABLISHED 1862

MAIN OFFICE AND FACTORY



MACHINE AND ERECTING DEPARTMENT



SHOWING LEFFEL TURBINES IN PRODUCTION

Our factory is located on several principal railroads and is of latest industrial design thruout, equipped with special motor driven machinery for produciton of Leffel turbine water wheels and accessories. We give all orders our most prompt and careful attention.

HYDRO-ELECTRIC POWER

FROM A

HOPPES HYDRO-ELECTRIC UNIT

A LOW COST SOURCE OF ELECTRICITY FOR FARMS, ESTATES, RANCHES, RESORTS, CLUBS, CAMPS, SMALL MANUFACTURING PLANTS, RURAL ELECTRIFICATION AND MANY OTHER USES.

BULLETIN H-49

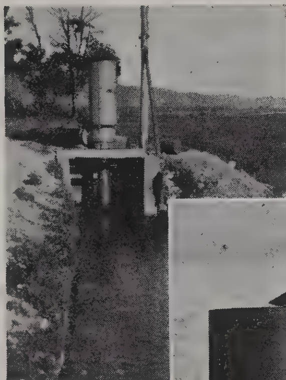


Fig. 1

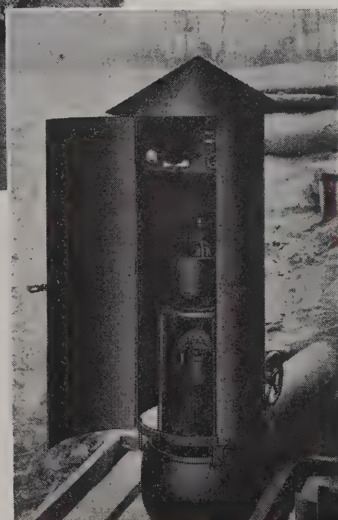


Fig. 2

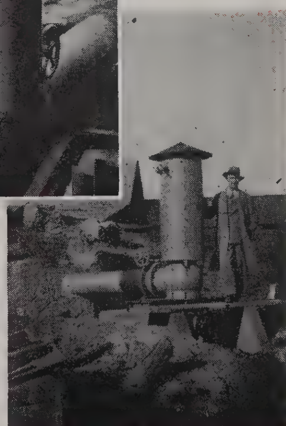


Fig. 3

MANUFACTURED BY

THE JAMES LEFFEL & COMPANY

SPRINGFIELD, OHIO, U. S. A.

Established 1862

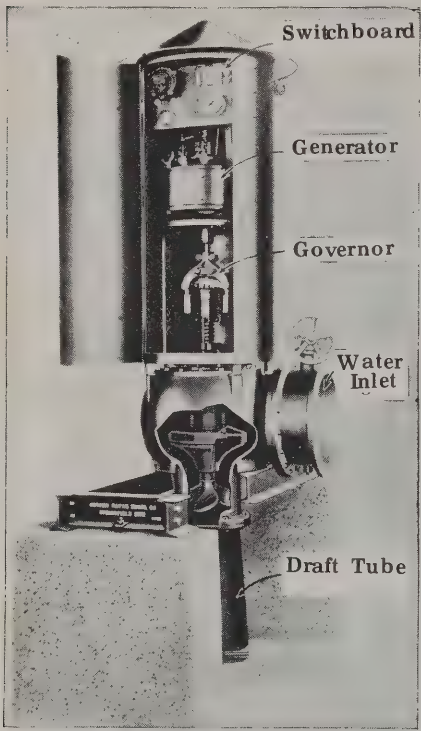


Fig. 4

Cutaway Section Showing Governor Control Valve.

The Hoppes Hydro-Electric Unit has been specially designed to provide an economical source of electricity and power for people in locations where otherwise it would not be possible to enjoy it. This unit will give continuous service. It will operate without noise and require no further service than for a small amount of lubrication.

This unit being of the efficient vertical design permits the generator and electrical equipment to be carried above flood water. This unit is direct connected. Troublesome and power absorbing gears and belts are eliminated.

The instrument board is equipped with voltmeter, switch, fused cutout, rheostat, and porcelain bushings to protect the wiring. The generator, instruments and governor are protected from the weather by a steel housing and the compact unit is furnished with an I beam foundation frame. A worm gear operated butterfly valve at the inlet permits shutting down the unit when desired. A tapered steel draft tube is furnished.

The turbine governor is mounted on the power shaft and regulates the speed of the unit. The interior view of the unit, Fig. 4, shows the stream line water passage, free from gates, links and other obstructions, which might cause it to clog with leaves and interfere with the water flow.

Fig. 5
1 K. W. Unit on a Ranch in Montana.

The generator is specially designed for use on this unit. The windings are carefully treated to protect them from moisture. The rotor shaft is mounted on ball bearings. This sturdy unit offers the high grade of performance necessary for the sensitive electrical appliances, household and otherwise now available. These units can be furnished for either direct or alternating current.

Hoppes Units have been in continuous operation for over fifteen years and have world-wide distribution. They produce electric current at its lowest cost and make use of water in streams, which might otherwise be wasted. In most cases a small dam is required and a pond thus created for power purposes can often be used also for watering stock, fire protection, recreation and many other purposes.

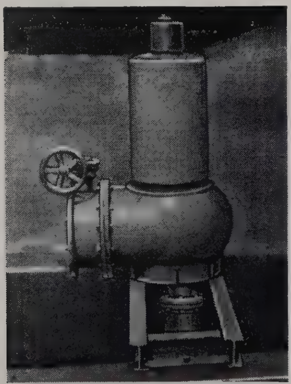


Fig. 6
Turbine With Governor Used for Driving Machinery.

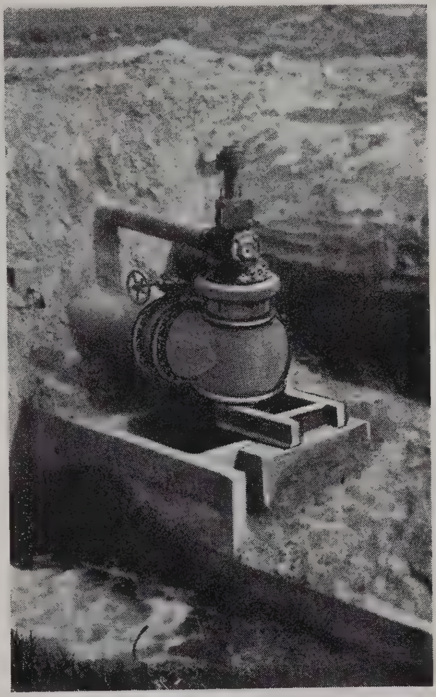


Fig. 7
Turbine Direct Connected to Centrifugal Pump.

The direct current plant is available with or without governor depending on the particular requirements of the individual installation. With or without a governor the design is such as to control the unit within sufficiently close limits.

The Hoppes Hydro-Electric Unit is used primarily for generating electricity. However, the turbine may also be used for other purposes, such as driving pumps for irrigation as in Fig. 7, or operating other machinery as indicated in Fig. 6.

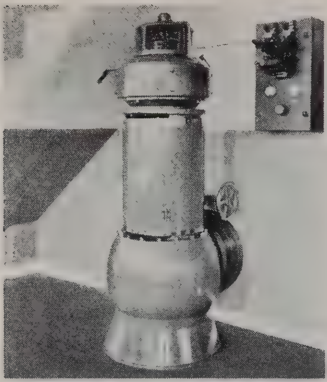


Fig. 8—5 K. W. Indoor Style in manufacturing plant in Michigan.

Fig. 9
2½ K. W. Unit on factory erection floor.

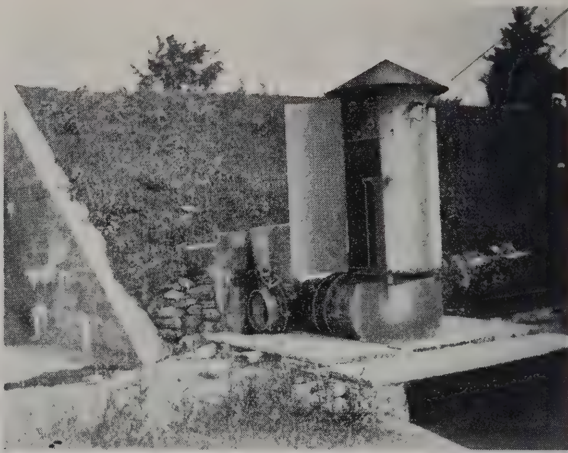


Fig. 11—5 K. W. Unit on an estate in New York.

These Pictures show some of the many installations of the Hoppes Hydro-Electric Units. Here is what some of our customers say about these units.

From an Estate owner in New York.

"After operating a Hoppes Hydro-Electric Unit for five years we find it very satisfactory. It has been used continuously during that time and operates as well in winter as in summer. It has cost us on an average of one dollar per year."

From an Agricultural College Professor in Oregon.

"I am glad to report that the Hoppes plant I bought some six years ago is giving me excellent service. It has been in practically continuous service thruout this period."

From a Lawyer in North Carolina.

"It gives me great pleasure to advise you that my Hoppes Hydro-Electric plant has been entirely satisfactory and its cost of operation trifling. I would not hesitate to recommend the plant to any one desiring to install an electric plant."

From Supt. of a Municipal Water Works Plant in Colorado.

"This plant has given good service and has been in continuous operation. It operates as satisfactory in winter as in

---

Fig. 10—5 K. W. Unit on a ranch in Montana.

Fig. 12—1 K. W. Unit on a farm in Ohio.

Fig. 13—5 K. W. Unit on a farm in Colorado.

summer. It gives good voltage regulation and the total cost of operation has been for a little grease and oil together with a few brushes."

From a Miller in Tennessee.

"Out plant has been in continuous operation since we put it in seven years ago. It has given almost perfect service so we would recommend it highly."

From a Farmer in Michigan.

"We have operated our plant since 1927 and aside from what it saves in light bills we get lots of enjoyment out of the pond; we have fish in the summer and skating in the winter."

From a Fish Hatchery in Texas.

"Our 3 K. W. plant has been in continuous operation since 1931 and furnishes light and power for 3 houses, radios, fans, mixers, refrigerators, water pump and other appliances. The performance of this plant has been very satisfactory and a very good investment."

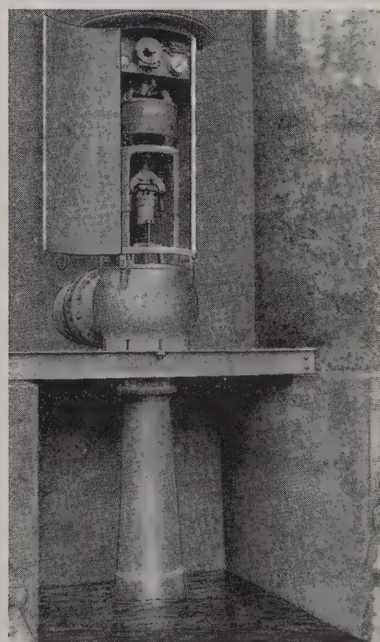


Fig. 14—5 K. W. Unit on a Dude Ranch in Montana.

From a Rancher in Montana.

"Our plant was installed in 1926 and has given us good service. It operates day and night."

From a Miller in Michigan.

"The Hoppes installation has given us good service going on ten years now, think $5.00 would cover all expense and would recommend the unit to any one having the water to operate it."

Fig. 15—5 K. W. and 1 K. W. Units on an estate in Wisconsin.

Rating Tables of Hoppes Hydro-Electric Units

ELECTRICAL CAPACITY	Head in Feet	Style	Water in Cubic Feet Per Minute
½ KILOWATT OR 500 WATTS	* 8	HL	104
	* 9	HJ	92
	* 10	HJ	82
	* 11	F	74
	* 12	F	68
1 KILOWATT OR 1000 WATTS	* 8	IL	190
	* 9	HL	175
	* 10	HL	155
	11	HL	140
	12	HJ	127
	13	HJ	118
	14	HJ	110
	15	HJ	105
	16	HJ	100
	17	HJ	94
	18	HJ	90
	19	F	84
	20	F	80
	21	F	76
	22	F	74
	23	F	72
	24	F	70
	25	F	68
2 KILOWATTS OR 2000 WATTS	* 8	JP	330
	* 9	JP	290
	* 10	JP	260
	* 11	HL	245
	* 12	HL	225
	* 13	HL	215
	14	HL	190
	15	HL	178
	16	HL	166
	17	HL	156
	18	HJ	153
	19	HJ	148
	20	HJ	140
	21	HJ	133
	22	HJ	127
	23	HJ	120
	24	F	116
	25	F	110
3 KILOWATTS OR 3000 WATTS	8	LR	470
	9	JP	415
	10	JP	370
	11	JP	340
	12	JP	310
	13	JP	280
	14	JP	260
	15	IL	250
	16	IL	240
	17	HL	225
	18	HL	210
	19	HL	200
	20	HL	190
	21	HL	180
	22	HL	170
	23	HL	165
	24	HJ	162
	25	HJ	158

ELECTRICAL CAPACITY	Head in Feet	Style	Water in Cubic Feet Per Minute
5 KILOWATTS OR 5000 WATTS	8	OT	760
	9	OT	600
	10	LR	590
	11	LR	535
	12	LR	490
	13	JP	470
	14	JP	435
	15	JP	400
	16	JP	365
	17	JP	340
	18	JP	330
	19	JP	320
	20	JP	315
	21	HL	300
	22	HL	290
	23	HL	285
	24	HL	275
	25	HL	260
7½ KILOWATTS OR 7500 WATTS	11	OT	800
	12	OT	740
	13	LR	680
	14	LR	630
	15	LR	590
	16	JP	550
	17	JP	515
	18	JP	490
	19	JP	480
	20	JP	450
	21	JP	430
	22	JP	410
	23	JP	400
	24	JP	390
	25	JP	380
10 KILOWATTS OR 10000 WATTS	12	OT	980
	13	OT	900
	14	OT	840
	15	OT	780
	16	LR	715
	17	LR	670
	18	LR	650
	19	JP	610
	20	JP	580
	21	JP	550
	22	JP	525
	23	JP	500
	24	JP	490
	25	JP	480

Head in feet referred to above is illustrated on page 7, Fig. 16.

Style refers to various sizes of Hoppes Hydro-Electric Units. See dimensions on page 7.

Quantity of water the unit will use at full rated capacity is listed above in cubic feet per minute.

*Units marked with * furnished in direct current only.

Standard rating for alternating current units is 3 phase 60 cycle and either 120 or 240 or 480 volts.
These Hoppes Hydro-Electric Units may also be furnished for 50 cycle current.
When you write us, please give full particulars on your electrical requirements.

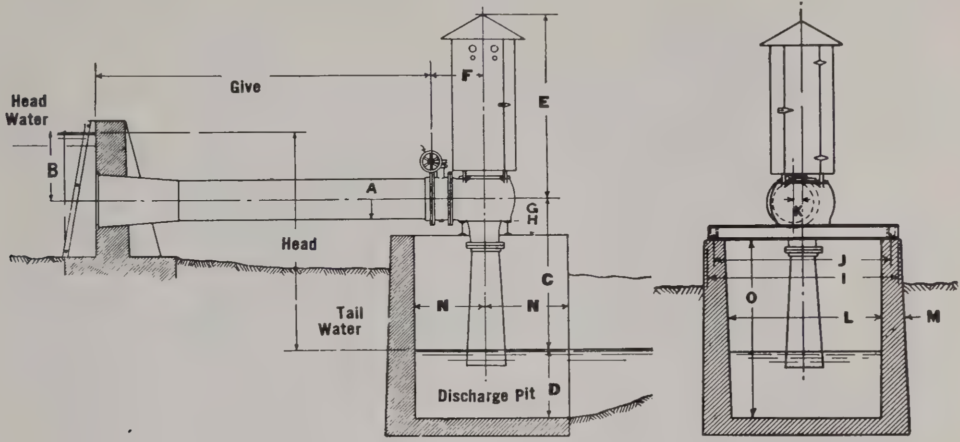


Fig. 16

Dimensions of various sizes of Hoppes Hydro-Electric Units are indicated in the above diagram and listed in the chart. Minimum distance from head water level to center of inlet pipe is given. Diameter of inlet pipe to connect with the unit is given. This inlet pipe should be short as possible.

GENERAL DIMENSIONS Style Sizes						
	F	HJ	HL IL	JP	LR	OT
A	6″	10″	12″	16″	18″	20″
B	18″	24″	24″	36″	36″	36″
C	60″	60″	60″	60″	60″	60″
D	24″	30″	30″	36″	42″	48″
E	58″	72″	72″	88″	90″	90″
F	20½″	18″	18″	22″	23″	27″
G	5½″	8⅝″	9⅝″	11⅛″	11⅞″	14¼″
H	5″	5″	5″	6″	6″	7″
I	72″	72″	72″	84″	84″	96″
J	66″	66″	66″	78″	78″	90″
K	3⅛″	4¾″	4″	4″	4″	4½″
L	60″	60″	60″	72″	72″	84″
M	8″	8″	8″	9″	10″	10″
N	30″	30″	30″	36″	42″	48″
O	73½″	73⅜″	75⅜″	78⅞″	84⅛″	86¾″

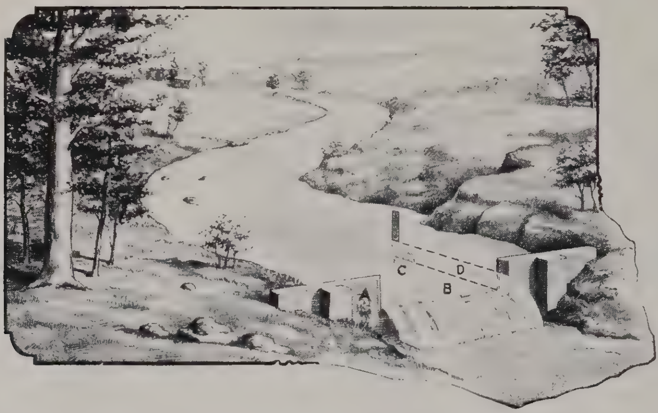
In addition to the examples of complete Hoppes Hydro-Electric Units illustrated and specified herein, many other styles of turbines may be furnished, see page 11. Our Engineering Department will gladly assist and advise you regarding any details relating to the installation of Hoppes Hydro-Electric Units or Leffel turbines. For over three quarters of a century we have specialized in the designing and constructing of hydraulic turbines of all kinds. With this background of experience we are prepared to furnish designs to meet your requirements.

IMPORTANT—Please Note:

In order that you may realize the most from this service, please give us all possible information concerning the hydraulic features of your power site using INFORMATION SHEET on page 9 as a guide.

HEAD OF WATER: This is the vertical distance (in feet) from head water surface down to tail water surface. The term "head" is graphically illustrated on Fig. 16 (above).

QUANTITY OF WATER AVAILABLE: See page 8 for illustrations for measuring the flow of streams. If possible give minimum and average stream flow in terms of cubic feet per minute.



INSTRUCTIONS FOR MEASURING QUANTITY OF WATER

First, select a suitable location in the stream where the water flows smoothly and place a board construction "A" across the stream to form a weir dam. This board should have a width of notch "B" in it about six times the greatest depth of water flowing over the weir. The notch should be beveled on the down stream side to almost a sharp edge, with the bottom of the notch not less than six inches above the water on the down stream side.

Drive a stake "C" about three feet up stream from the weir, to a depth that the top of the stake will be exactly level with the bottom of notch "B". When all the water is flowing over the weir measure the depth "D" over the top of the stake, then read the table which gives the cubic feet per minute for each inch in width of notch "B". Multiply the number just found by the inches of notch width which will give the flow in cubic feet per minute.

On larger streams select site as above. Measure the average water depth between edges. Also measure average width. Floats consisting of short wooden strips weighted so as to be submerged two-thirds of their height should then be placed in the stream so as to measure the average distance carried in a minute. All measurements to be in feet and at the same relative location. The product of depth, width, distance and the constant .8 will give the approximate flow in cubic feet per minute.

TABLE SHOWING THE QUANTITY OF WATER PASSING OVER WEIR IN CUBIC FEET PER MINUTE FOR EACH INCH IN WIDTH FOR NOTCH B

INCHES DEPTH OVER STAKE D		⅛ Inch	¼ Inch	⅜ Inch	½ Inch	⅝ Inch	¾ Inch	⅞ Inch
1 Inch	.40	.47	.55	.65	.74	.83	.93	1.03
2 "	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3 "	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4 "	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5 "	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6 "	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7 "	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8 "	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9 "	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10 "	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11 "	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12 "	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13 "	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14 "	21.09	21.37	21.65	21.94	22.22	22.51	22.70	23.08
15 "	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16 "	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17 "	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18 "	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19 "	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20 "	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21 "	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22 "	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23 "	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24 "	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

TEAR OFF HERE

INFORMATION SHEET

Refer to page 7 describing term "head" Refer to page 8 for methods to measure quantity of water in cubic feet per minute.

Make a sketch on rear side of this sheet showing arrangement of your power site and indicate how you believe a unit can be installed.

Please fill in accurately all information requested, tear sheet out of bulletin and return for our recommendations and quotation.

THE JAMES LEFFEL & COMPANY,
SPRINGFIELD, OHIO, U. S. A.

What head can be developed?............feet

Average Stream Flow (cubic feet per minute)............Minimum Flow............Maximum Flow............

What pondage will be formed above the dam?............Acres

How high does tail water raise during floods?............feet

Is the Site developed at present?............

Give distance from dam to where plant will be installed............feet

Give distance from plant to point of power use............feet

What kilowatt capacity is desired?............ Alternating current............ or Direct current............

Volts............Phase (If A. C.)............Cycle (If A. C.)............

Are

What

NAME............Date............

Street No. or R. F. D.............County............

City............State............

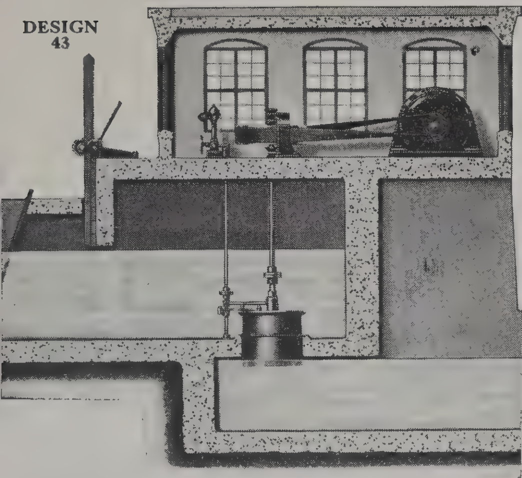
MAKE A SKETCH OF POWER SITE

Showing How You Believe Installation Can Be Made

TEAR OFF HERE

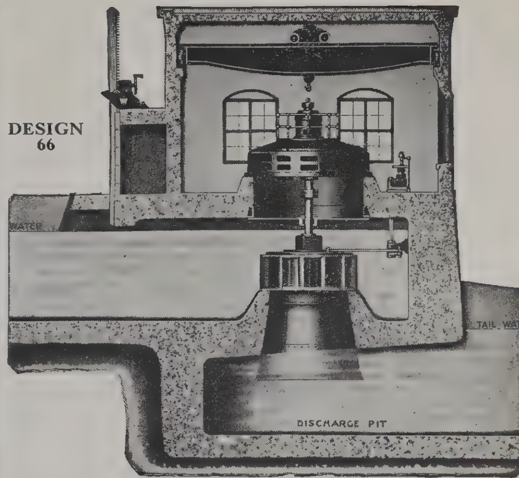
THE VIEWS BELOW ILLUSTRATE A FEW OF THE MANY OTHER DESIGNS OF TURBINES WE MANUFACTURE—SEND FOR FULL PARTICULARS.

DESIGN 43

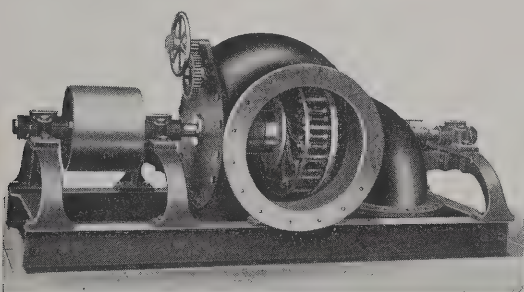


We also furnish Leffel vertical turbines equipped with vertical shafting and pulley with quarter twist belt and tightener driving generator.

DESIGN 66

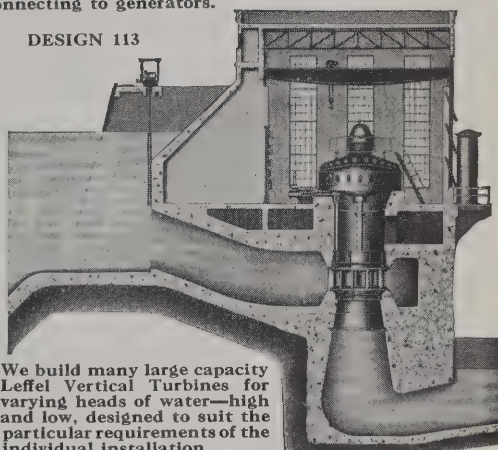


We design and furnish Leffel vertical turbines developing high speeds, high powers, high efficiencies, for direct connecting to generators.

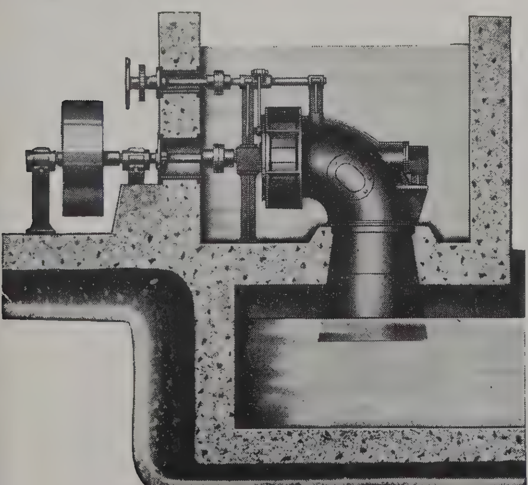


DESIGN 7. Single Discharge Leffel Horizontal Turbine Self Contained, specially desirable for small powers installed under high heads, belt or direct connection drive.

DESIGN 113

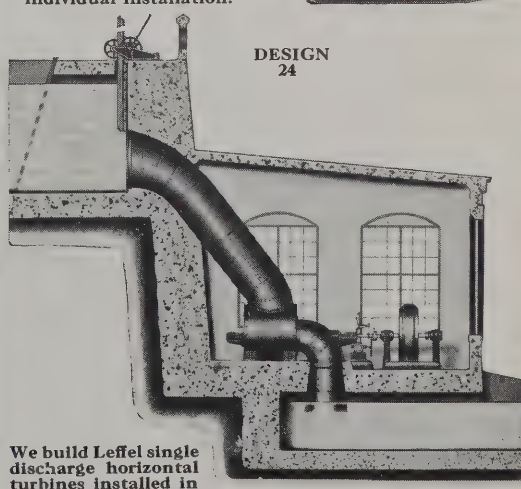


We build many large capacity Leffel Vertical Turbines for varying heads of water—high and low, designed to suit the particular requirements of the individual installation.



DESIGN 25. Leffel Single Discharge Horizontal Turbine for installment in open penstock under low and medium heads. Plans and prices quoted upon request. This makes very simple installation.

DESIGN 24

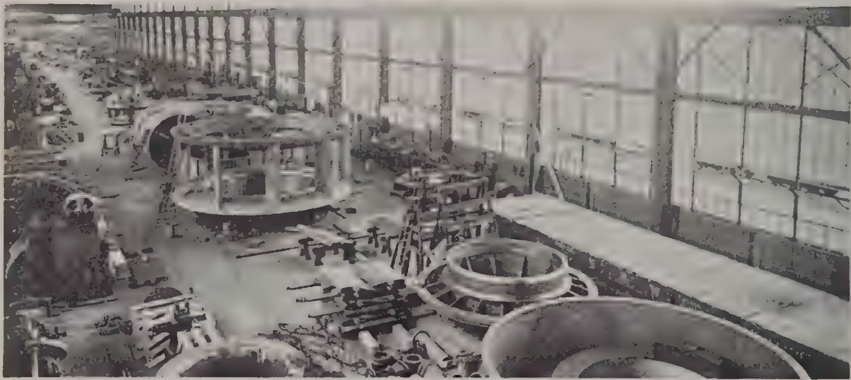


We build Leffel single discharge horizontal turbines installed in steel casings with shafts fitted for direct or pulley drive. Oil thrust bearings water cooled.

THE JAMES LEFFEL & CO.

ESTABLISHED 1862

MAIN OFFICE AND FACTORY



MACHINE AND ERECTING DEPARTMENT

SHOWING LEFFEL TURBINES IN PRODUCTION

Our factory is located on several principal railroads and is of latest industrial design thruout, equipped with special motor driven machinery for production of Leffel turbine water wheels and accessories. We give all orders our most prompt and careful attention.

— OUR 118th ANNIVERSARY YEAR —

THE JAMES LEFFEL & CO.

Telex
205419
TELEX 205419
CABLE ADDRESS
"LEFFEL SPRINGFIELD OHIO"
TELEPHONE 323-6431
AREA CODE 513

MANUFACTURERS OF
HYDRAULIC TURBINES
SCOTCH BOILERS - STOKERS
SPRINGFIELD, OHIO, U.S.A.
45501

ESTABLISHED 1862

June 10 1980

D Dillon
The Whatever Works
1142 Chestnut Avenue
Cott age Grove
Oregon 97424

Re: W80-1693

Dear Mr Dillon

In accordance with your recent request, we are pleased to send you catalogs pertaining to water power.

Pamphlet "A", which is one of the items enclosed, gives instructions on how to determine the "Head" under which the turbine will operate and the quantity of water in terms of cubic feet per minute. This information is needed so that we can determine the type of turbine most suited for your needs.

Our Hoppes Unit, Bulletin H-49 and Sheet 56-1 enclosed, is ideal for small installations. However, we build turbines of all sizes to suit the quantity of water available.

When we hear from you in regard to the "Head" and quantity of water, we will be able to make our recommendations as to the type of unit suitable for your needs and quote you prices.

Again, many thanks for your inquiry and we are looking forward to hearing from you in the near future.

Sincerely,

J. R. Brown

J. R. Brown
Sales Manager

JRB:gp
Enclosures

FLOW-THRU TURBINE

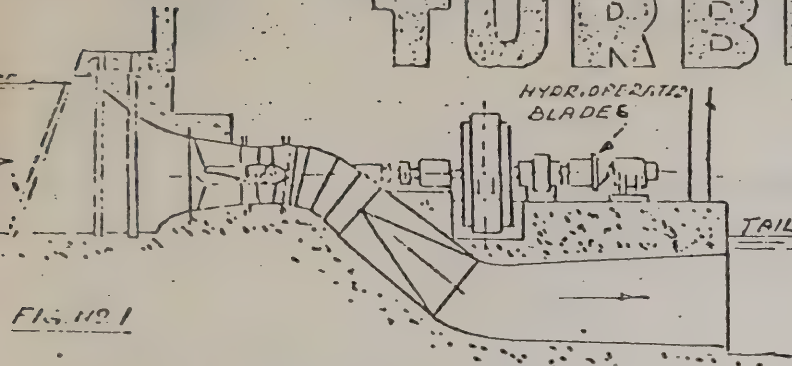


FIG. Nº 1

ADJUSTABLE BLADE FLOW-THRU TURBINE

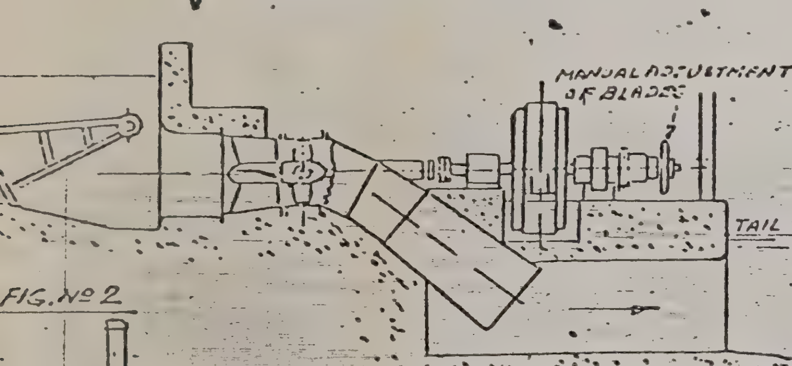


FIG. Nº 2

LOW HEAD ADJUSTABLE BLADE FLOW-THRU TURBINE

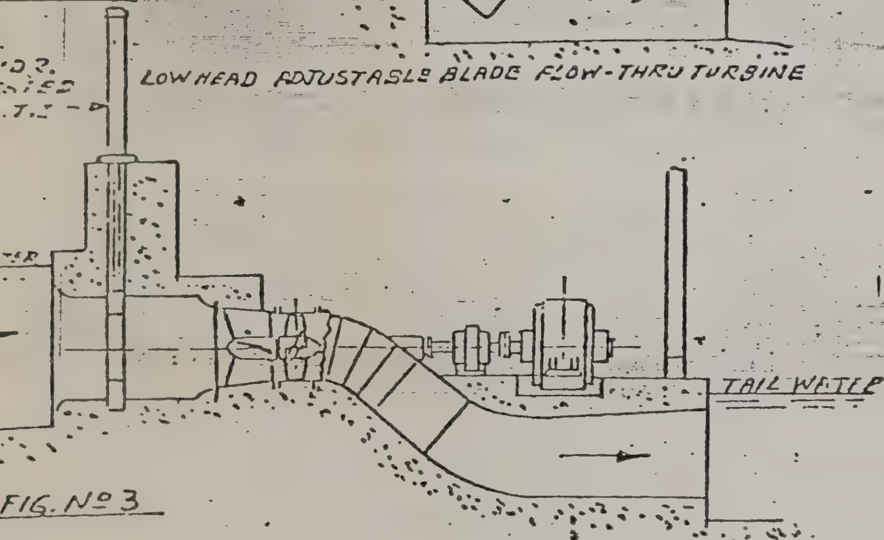


FIG. Nº 3

FIXED BLADE FLOW-THRU TURBINE WITH INDUCTION GENERATOR

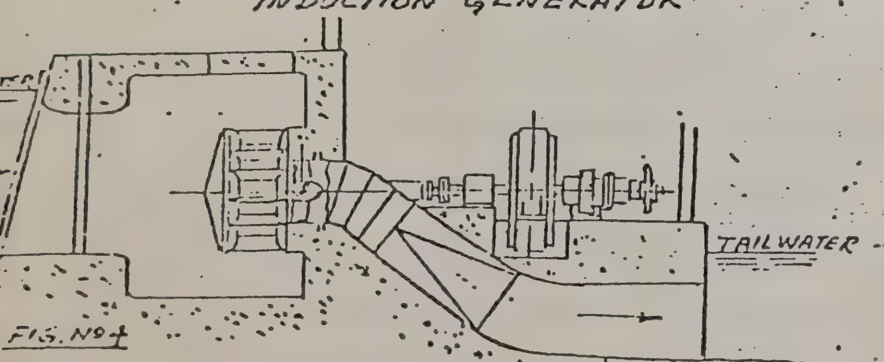
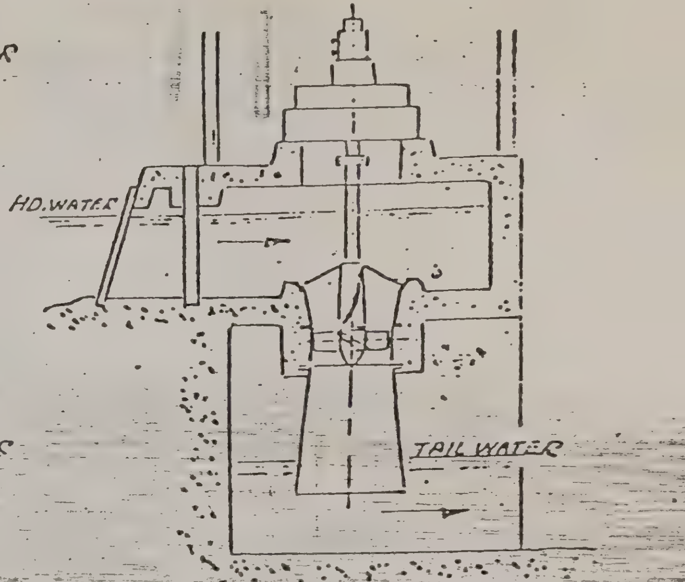


FIG. Nº 4

LOW HEAD FIXED OR ADJUSTABLE BLADE TURBINE WITH COMPLETE WICKET GATE CASING



VERTICAL FIXED OR ADJUSTABLE BLADE FLOW-THRU TURBINE

FIG Nº 5

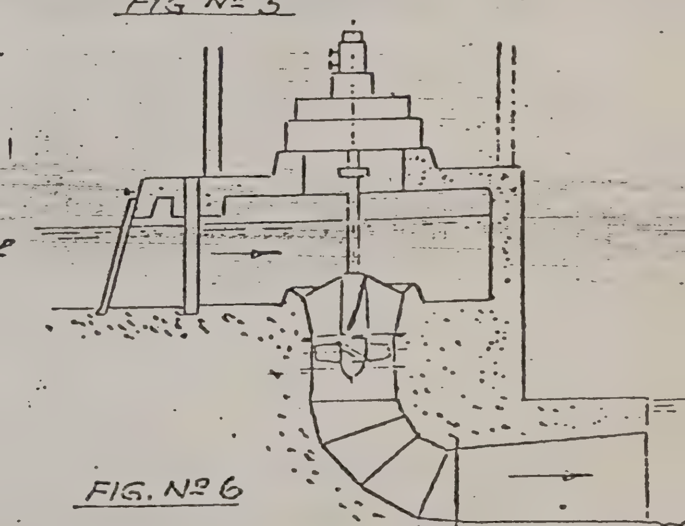


FIG. Nº 6

VERTICAL FIXED OR ADJUSTABLE BLADE FLOW-THRU TURBINE.

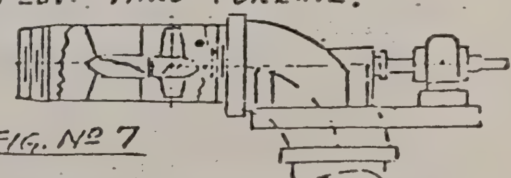


FIG. Nº 7

SMALL HORZ. FLOW-THRU TURBINE (WATER MOTOR TYPE)

THE JAMES LEFFEL & CO.

DEPARTMENT W

SPRINGFIELD, OHIO. U.S.A. 45501

TAMPELLA news release

Contact: Andrew J. Lazarus
A.J. Lazarus Associates, Inc.
12 East 41st Street
New York, NY 10017
(212) 689-1424

FOR RELEASE ON OR AFTER
THURSDAY, MARCH 13, 1980

NEW WORLDWIDE HYDROTURBINE COMPANY
FORMED IN SCANDINAVIA; U.S. PLANT INCLUDED IN ORGANIZATION

Trollhaettan, Sweden -- A new worldwide hydroturbine organization was formed here today (March 13) as three manufacturing facilities were linked into the format of Nohab-Tampella AB, a Scandinavian company formed by Bofors-Nohab (Trollhaettan) and Tampella OY of Tampere, Finland.

Basically, the two companies are equal partners in the new Nohab-Tampella AB company, which also includes the manufacturing facility of The James Leffel & Co. of Springfield, Ohio, which was acquired by Tampella in late 1979.

The new Scandinavian company takes over marketing, including project follow-up and sales, technical service, product development and design, as well as project management for the combined organization's range of large and small water turbines. Production is to be at the manufacturing plants within the parent companies, including Trollhaettan, Tampere and Springfield. First year's sales are expected to be about $50 million.

(more)

The new company creates a strong organization, combining Bofors-Nohab's position in large water turbines for use with higher heads and Tampella's traditional specialty in low-head turbines. As a result, the new company will be a major supplier of hydroturbines in the world market.

Peter von Koskull, marketing director of Tampella's Engineering Division and head of Tampella's turbine group, has been appointed President of the Nohab-Tampella Turbine Group.

The changing market scene, with a strong interest in replenishable energy forms and with increased demand for water power, has motivated this joint offensive, according to von Koskull. The product program covers turbines from 30 KW to 500 MW. The activities of the company include the development of complete small-scale hydropower stations.

In the new organization, the Swedish company, Nohab-Tampella AB, with its home office in Trollhaettan, owns the Finnish company, OY Nohab-Tampella AB, in Tampere. where the new group management is also located.

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LEFFEL

PAMPHLET

"A"

THE JAMES LEFFEL & CO.

SPRINGFIELD

OHIO

HINTS ON THE DEVELOPMENT OF SMALL WATER POWERS

This pamphlet has been prepared for those who contemplate the construction of small water power plants on small streams for the purpose of generating electric current for general home use, and it is intended to convey certain information in order that the subject may be grasped by those unacquainted with the general rules and requirements for such developments.

It is generally understood by all that a flowing stream may be made to produce power, but it is not generally understood what information is required by the manufacturer of water power equipment in order that proper advice and recommendations may be given. Therefore we are outlining below the rules and requirements that must be observed when asking for information pertaining to the development of water power. We will add that the subject matter of this pamphlet applies principally to the smaller developments, but, at the same time, the same rules may be applied to the larger developments to a certain extent.

FALL OR HEAD

In order to produce power from a flowing stream there must be a "fall" in the stream. This "fall" is almost always augmented, or increased by the construction of a dam. A dam in the stream is necessary in order to raise the water to a maximum level to create a head, and to divert the water from the stream to the turbine, or water wheel. This head that is created is the vertical distance from the surface of the water at the dam down to the surface of the water in the stream below the dam and at a point where the turbine will be located.

As the useful power that may be produced from any waterpower is the direct product of the "head" and the weight of the water, which weighs 62.34 lbs. per cubic foot, it follows that the "head" available and the amount of water flowing in the stream in cubic feet per minute are absolute factors when it is desired to compute the amount of power that may be developed.

It will be understood that the term "fall" means the natural fall or drop in the course of a stream, and that the term "head" defines the vertical drop resulting from the construction of a dam in the stream. Please note Design 30 illustrating how this term is applied to a turbine installation.

HOW TO DETERMINE THE "HEAD"

When selecting the dam site it is well to remember that the higher the dam is built the more the "head" will be, and the greater the "head" the more power a given amount of water will produce; and the smaller will be the turbine. Therefore, it is well to exercise care in the selection of the dam site so that the highest possible head may be realized. However, consideration must be given to the cost and possible damage to your neighbor's property. Usually the topography of the ground will suggest the logical location for the dam, although there are other determining factors to be taken into consideration, such as character of foundation, property lines, pond area, etc. Space does not permit a more detailed treatment of these subjects. We will say, however, that it may be well to have an engineer or surveyor run out "contour lines" upstream from the dam site representing proposed water levels back of the dam. In this manner the flooded area may be determined before the dam is built, and serious complications avoided if such there may be.

After the height, or elevation, of the water back of the dam has been established, levels may be run downstream with an engineer's level or transit to determine the "fall" or "head" that may be secured below the dam site within a reasonable distance. It follows that the TOTAL HEAD that may be secured is that which is created by the dam plus the "fall or head" that may be secured below the dam. This TOTAL HEAD is represented by the VERTICAL DISTANCE from the surface of the water back of the dam down to the surface of the water below the dam and at the point where the turbine may be located.

If the developed "head" is low; that is, from a few feet up to ten to fifteen feet, the turbine is usually located right at, or very close to the dam, the water being conveyed to the turbine through an open flume or penstock. But, in some cases, where the head is not any greater than mentioned above, the turbine may be quite small and for that reason alone it might be more economical to convey the water to the turbine through a steel pipe line.

In some cases, regardless of the head secured, it is desirable to place the turbine some little distance below the dam to secure additional head due to the fall of the stream below the dam. In such cases a pipe line, or an open flume or open ditch may be used to convey the water to the turbine. However, there are cases where an open tail race may be excavated from the stream to the powerhouse to secure at least part of the fall below the dam; this being less expensive than the above mentioned pipe line or ditch.

MEASUREMENT OF WATER FLOWING IN THE STREAM

The second absolute factor that determines the amount of power that may be developed is the quantity of water available for power purposes flowing in the stream. Quantity of water for power purposes should be expressed in "cubic feet per minute" (C.F.M.).

There are two well known methods of measuring streams; one by the weir method and the other by the float method. Both methods are fully described and illustrated on a leaflet attached to this pamphlet.

There are cases where it is obvious that the water supply is more than adequate for the power to be developed but in most cases it is highly important that the water be carefully measured.

It will generally be found that the flow of water in any stream will vary greatly with the season of the year and this should be taken into consideration when measurements are taken.

The minimum flow of a stream, in most cases, has a duration of several weeks during the dry season, and this flow, when taken into consideration, represents the amount of water that can be developed continuously, or 100% of the time outside of that period of time the stream may be in flood stage.

As the flow of the stream increases, the amount of power that may be developed increases, although it is true that as the flow increases the actual head on the turbine is decreased somewhat on account of a greater quantity of water being discharged into the tail race which raises the level of the water therein.

As the flow increases beyond the normal, or average stage the head is reduced still further. However, periods of high water and low head are of comparatively short duration and while this condition must be contended with, it should not be allowed to stand in the way of the development of the water power.

It is obvious that a stream should be measured at various times of the year in order that complete data on the flow be established. Daily measurements are ideal and may be made conveniently, especially if the weir method of measuring is used.

It is also obvious that any measurement taken during flood period would be of little value except that such measurements may be used to estimate the size of the flood or waste gate in the dam. It should be noted here that if the stream is subject to floods, provision must be made in the dam to allow the excess water to escape; thereby preventing damage to the dam and powerhouse structure.

EFFECT OF PONDAGE

When a dam is built in a stream there is created back of the dam a pond that is really a storage reservoir that may be used to very good advantage to conserve the supply of water during times when the turbine is consuming less water than is flowing in the stream, and to supply water over and above that flowing in the stream when it is needed. If the pond is of sufficient area the above feature is of much benefit during times when the stream is at minimum flow.

In further explanation it may be stated that the load on any plan is seldom, if ever, fixed as it may and will vary with the needs of the power consumer. For example: Let us assume that the maximum capacity of the turbine is 600 cubic feet of water per minute, and that the load on the turbine at the moment requires all of this water to develop the power required by the load. Assume also, that the flow of water in the stream at the same time is only 300 cubic feet per minute. It will be seen that the turbine will consume the 300 cubic feet of water flowing in the stream plus 300 cubic feet more per minute which will be drawn from the pond. Now assume that in a short time the load changes to the extent that the turbine only requires 100 cubic feet of water per minute. Inasmuch as there are 300 cubic feet of water flowing in the stream and the turbine only requires 100 cubic feet of it, the difference, or 200 cubic feet of water per minute, will be stored in the pond to replace that which was drawn out.

A great many water-power feed and flour mills depend a great deal on pondage as they operate during the day, drawing on the pond for excess water not supplied by the normal flow of the stream. At night they shut down and the flow of the stream refills the pond which allows them to start the next morning with a full pond.

From the above we believe it will be seen how important and necessary the pond is to the successful operation of a water power plant during times when the normal flow of the stream is not great enough to supply the maximum capacity of the turbine installed. In other words one may take advantage of the existence of a pond and install a larger turbine than he could otherwise, and, thereby, be able to carry a greater momentary, or peak load for short times.

Therefore, the area of the pond created by the dam should be given along with the information regarding the head and the quantity of water. The area of the pond may be given approximately and in terms of acres.

ESTIMATING THE POWER REQUIRED

As this pamphlet is principally for those who desire to install water power equipment to drive generators for furnishing electric current for home and farm use, we will confine our remarks to that type of load.

It may be your wish to furnish electricity to only a small cottage, a group of cottages, a group of farm buildings, or perhaps, to a private estate including all the buildings thereon. But, whatever it is, there are certain items of information we should have to be able to advise you regarding the amount of power required to accomplish the results you desire.

A list of the total number of electrical outlets in all of the buildings should be made, and this list should include only the outlets for electric lights.

Then, in addition, list all of the electrical appliances that may be used, including heaters, flat irons, radios, television sets, electrical ranges, milking machines, cream separators, etc. With such a list at hand we can then estimate the approximate peak load that would have to be carried by the turbine and helps us to decide on the proper size of turbine and accessory equipment.

TYPES OF ELECTRIC GENERATORS

There are two types of electric generators that may be used, and we are referring to their electrical characteristics in this instance. One type generates Alternating Current and the other type generates Direct Current. The type to be selected depends on a number of factors which must be given consideration. Alternating Current may be transmitted much greater distances than Direct Current without undue loss and with smaller wires. Therefore, the distance from the power plant to the place where the current will be used is a very important factor and should be stated in your inquiry.

The size of the generator is another factor, but that is determined when the power of the turbine is determined, and, therefore, this will be taken into account when the recommendations are made.

The type of equipment to be operated by the electrical current is, also, a factor, and it is well to remember in this connection that any electrical apparatus having heating elements, such as light bulbs and heaters, may be operated by either Alternating or Direct Current. On the other hand, any apparatus operated by electric motors must be equipped with either Alternating Current motors or Direct Current motors as it is substantially true that it is impossible to have a motor that will operate on both A.C. and D.C. current.

If your buildings are already furnished with Alternating Current equipment it is a very deciding factor in the selection of the generator, irrespective of the distance the current must be transmitted. But, if this apparatus is yet to be purchased, consideration may be given to the selection of a Direct Current generator and equipment to suit. Direct Current generators are generally less expensive than the A.C. type, and, if wound in a certain specific manner for constant voltage, expensive governing equipment for the turbine equipment may be omitted.

For additional information on this subject please write to any of the principal electrical manufacturers, or confer with your local electrician.

TYPES AND STYLES OF TURBINES

THE JAMES LEFFEL & COMPANY, with main office and factory located at Springfield, Ohio, having manufactured turbine water wheels since 1862, have many lines of patterns from which a selection may be made to fit practically every condition of installation. We are prepared to furnish turbines developing fractional horsepower up to thousands of horsepower, and these are made in many different styles to meet the requirements of our customers.

No inquiry is neglected regardless of the size of the equipment involved, and each and every inquiry is given prompt and careful attention. We earnestly desire that the party making inquiry correspond with us freely, and we will do everything within our power to advise and counsel him to the end that when the plant is completed it will be a thing of usefulness and not a failure. We urge you to accept our advice and suggestions BEFORE work is started. Altogether too many people have come to us for advice AFTER they have attempted to make an installation, relying on their own limited knowledge of an art that is highly specialized. They have nothing to their credit but failure, loss of time and much money which, if properly directed in the beginning, would have spelled success.

The successful completion of a waterpower plant is not a difficult problem if it is properly engineered in the beginning. If the owner will realize that the problems confronting him are of an unusual nature and that to solve them properly requires special training, he will not start construction or expend his resources without proper advice.

We have endeavored to show in this pamphlet what information we must have in order to properly advise those who are contemplating the construction of small water power plants, and, on receipt of this information, we will promptly advise the amount of power that may be developed, together with a suggestion as to the type and size of turbine that would best suit the conditions. Quotations on the equipment will also be given at the proper time.

At this point we might describe in detail the various types and styles of turbines which we are in position to furnish, but to do so would have a tendency to confuse and we would, therefore, prefer to dwell on this matter at length after the first preliminary information is at hand which is covered in this pamphlet. We will, however, describe briefly a few of the more common types of turbines and their application.

A turbine water wheel is a device for transforming the energy of falling water to power in a form which may be applied to the driving of machinery, electrical or otherwise. The empounded water back of the dam flows into a flume or penstock which is built into the dam, and from thence, it flows through the turbine and into what is known as a discharge pit, or tail race, eventually reaching the stream again below the dam.

Attached to this pamphlet is a special, illustrative page entitled "IMPROVED VERTICAL SAMSON TURBINES" and if this page is referred to it will be noted that a turbine consists of three principal parts; the runner and shaft, which are the parts that rotate; the gate or guide casing which contains the adjustable gates for guiding the water into the runner; and the discharge cylinder, or draft tube, which conveys the water to the discharge pit, or tail race, after it has left the runner.

A turbine may be installed in a vertical or horizontal position, but the vertical position (like Design 30) is to be preferred as it is usually more economical and efficient. The illustrative page referred to above shows a typical, vertical, open flume turbine. When this type of turbine is installed an extension shaft is attached to the coupling on the top end of the turbine shaft, and on this extension shaft is mounted a pulley for driving a generator by means of a quarter turn belt. Necessary bearings are also mounted on this extension shaft. Examples of quarter turn belt drives may be found in our bulletin No. 38, copy of which will be sent on request.

The flume in which the turbine is installed is usually built of concrete, but sometimes wood or steel is used. An open flume or penstock is one that is open at the top to the atmosphere, and a closed flume is closed at the top which is below headwater level. In this case (closed flume) the extension turbine shaft and the gate operating shaft pass through suitable packing boxes in the top of the flume.

When turbines of small capacity are used under heads of water of about fifteen feet or more, they are often installed in steel or cast iron cases and the water is conveyed to the turbine by means of a pipe made from steel or wood.

In all cases the turbine is fitted with a set of adjustable gates of the wicket type that may be open or closed to any degree from closed position to open position, and they are located in the gate, or guide casing mentioned above. These gates are used to regulate the flow of water through the turbine runner, and thus regulate the power and speed of the turbine.

In many cases the adjustment of the turbine gates is accomplished by means of a suitable handwheel located at a convenient place in the powerhouse, and connected to the turbine gate operating mechanism by suitable shafting. In other cases the adjustment of the turbine gates is accomplished by an automatic governor, which automatically adjusts the turbine gates to maintain a constant speed on the turbine when the load is diminishing or increasing. When used this governor is located in the powerhouse and is arranged in such a manner that the turbine gates may be operated by hand if desired.

Whether or not a governor is needed depends on the size of the turbine, type of load on the plant, type of generator used, and the desirability for good speed regulation. It is also a factor in the cost of the equipment as the governor cost is sometimes as much as that of the turbine equipment if the turbine is small. These as well as related questions are covered in detail when the quotation is made.

In instances where the turbine is installed in concrete or wooden flumes, we consider it our duty and a part of our business to furnish information showing the proper size, or the internal dimensions of such flumes, as it is of the utmost importance that these flumes be built sufficient in size to handle the water without undue loss in head. It is well to note here that the water flowing in the flume flows at a velocity determined by the size or area of the flume, and, as it requires a certain amount of head to produce a given velocity, it follows that the higher the velocity the more head is required to produce that velocity. This head is lost to the turbine and, therefore, does not produce power. It is highly important, therefore, that the flume, pipe line or penstock, as well as all the water passages conveying water to the turbine be designed with ample dimensions, and we do all that is possible to see that this type of construction is carried out. But, all too frequently, we find flumes and penstocks designed and built altogether too small for the size of the turbine installed. The result is that the turbine does not operate under the head expected and the owner is sorely disappointed with the performance of the plant.

TRASH RACKS AND HEAD GATES

To prevent trash and floating material from getting into the turbine and plugging up the water passages with a resultant reduction in power and efficiency, and, also, possible damage to the turbine, it is highly desirable to install at the head of the flume or penstock a suitable trash rack made from steel bars set on edge to the flow of the water and properly spaced according to the size of the turbine. It is usual to design trash racks so that the maximum water velocity does not exceed one and one-half feet per second.

Just back of the trash rack should be installed suitable head gates that may be operated easily to close the water out of the flume or penstock to allow the turbine equipment to be inspected, cleaned, or repaired as the case may be.

We manufacture both trash racks and head gate hoisting equipment and we will furnish further information regarding these items on request.

OLD WATER-POWER PLANTS REMODELED

It often happens that an old, abandoned water-power plant is purchased and it is desired to have it remodeled and brought up to date. In such cases it is well for us to know this in the beginning, as we have records of many of these sites, and such information means a saving not only to the customer but to ourselves as well. Quite often existing structures may be saved, and if the old flumes or penstocks are to be used we should have full information regarding them. In most instances of this kind it is desirable to have one of our engineers visit the site in order to get first hand information and data.

SERVICES OF AN ENGINEER

As mentioned in the above paragraphs, we are prepared to have one of our expert engineers visit the water power site to collect the necessary information and data on existing water power structures to assist in the planning of the application of new turbine equipment. This engineer would also be competent to take measurements of the head and to go over the ground in a preliminary manner, advising to the best of his ability and experience, whether or not the project is practical.

Arrangements for the services of such an engineer may be made on written application to The James Leffel & Company, Engineering Department, Springfield, Ohio.

IN CONCLUSION

We have discussed in a general way in this pamphlet several items of information that should be given us when inquiry is made regarding the possibilities of small water powers and, in conclusion, we will group these items in condensed form on the following page in order that they may be readily taken into consideration and proper reply made.

• • • • • • •

Please fill out the attached perforated sheet completely — tear it out and return to —

THE JAMES LEFFEL AND COMPANY
SPRINGFIELD
OHIO

TO:

THE JAMES LEFFEL AND COMPANY
SPRINGFIELD
OHIO

1. Give Head or Fall of water in feet ____________________

2. Give quantity of water available in cubic feet per minute ____________________

____

3. Estimation of number of electrical outlets and electrical appliances to be used ____________________

____

____

4. Give approximate area of pond above dam in acres ____________________

5. Give distance from powerhouse to where electric current will be used ____________________

____

6. Give approximate distance from dam to powerhouse ____________________

7. Will plant be all new or will an old plant be remodeled? ____________________

____

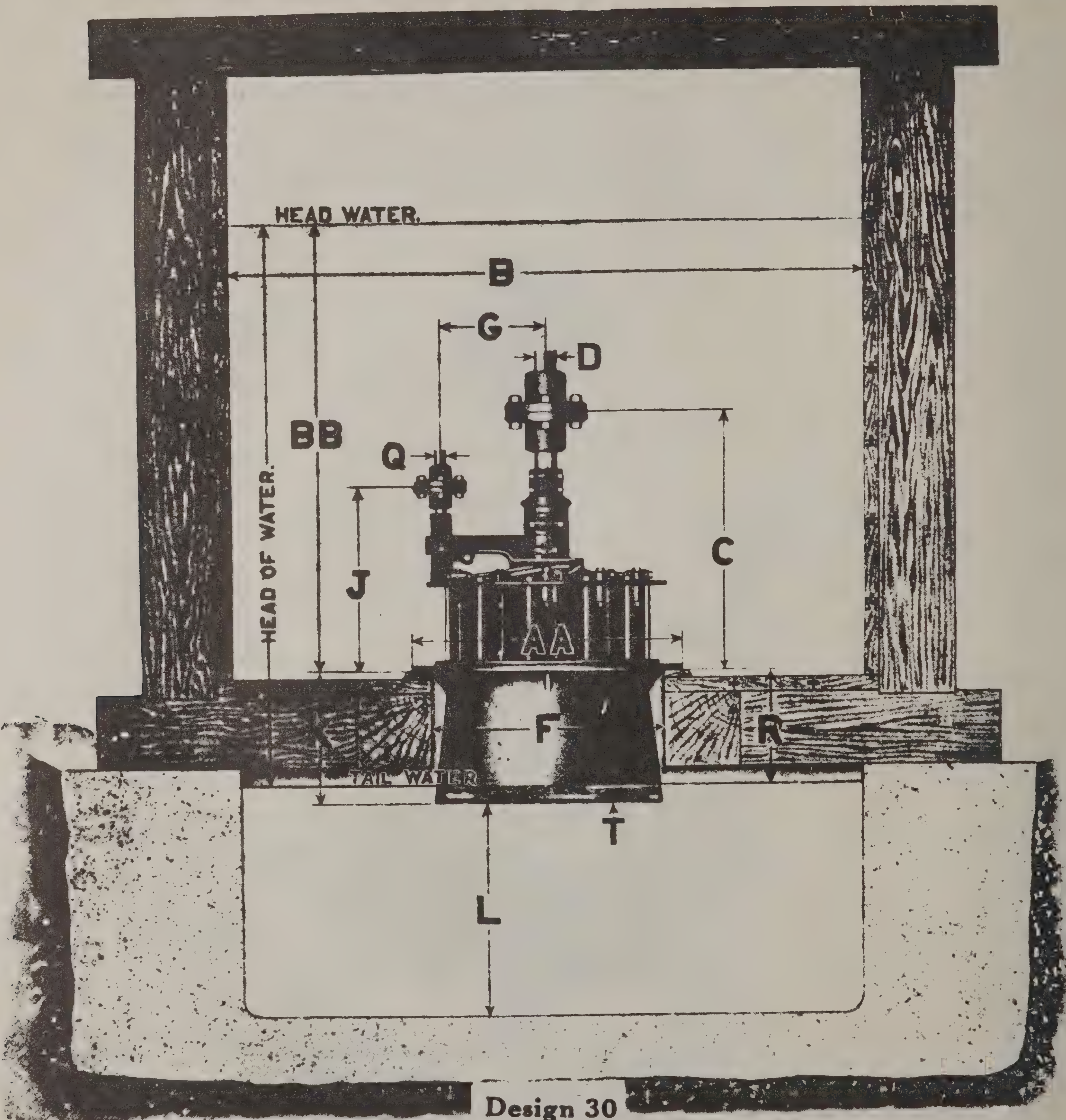
REMARKS AND SKETCHES:

(Signed) ____________________

Post Office ____________________

____________________ Date ____________________

THE JAMES LEFFEL & CO



Design 30

SPRINGFIELD, OHIO. U.S.A.

ESTABLISHED 1862

Different Methods With Instructions For Measuring Water

Measuring Flow of Water by Weir Method

After deciding upon suitable location for the new power plant, the following preliminary measurements must be obtained:

FIRST, obtain in feet the head of water This is the vertical distance from the surface of water above dam down to the tail water surface below dam at the place where turbines will be located.

SECOND, obtain minute cubic feet of water. Several methods may be used, the easiest and most commonly used methods are as follows:

If the stream is large, select place where water flows slowly for some distance between parallel banks and where the bottom of stream is fairly even. Then carefully space and measure the cross sectional area of water in square feet. Then place a float that sinks well down into the water in the center of stream and accurately measure the distance in feet the float travels in one minute. Then multiply this distance by the cross sectional square feet area, and eighty-three per cent of this result will be approximately the minute cubic feet of water flowing in the stream. Or,

If the stream is small the water can be measured by weir. (See the above illustration.) Select first a suitable location in stream where water flows slowly, then place a board with notch in same, forming a weir dam; the down stream edge of weir notch beveled almost to a sharp edge; the width B must be about six times the greatest depth of water flowing over weir. The bottom edge of weir not less than one foot above the surface of water below the down-stream side of weir. Then drive a stake up stream several feet above weir. The top of stake must be exactly level with bottom edge of weir. When all water is flowing over weir, measure the depth C over top of stake, then read above weir table which gives the minute cubic feet of water 1 inch wide flowing over weir. Example: Assume width B of weir as 70 inches, depth C as 12½ inches. Look down the first column in weir table to 12 inches, then horizontally to column under ½ inch. The minute cubic feet flowing over weir 1 inch wide, 12½ inches deep will be 17.78 multiplied by 70 inches, the result is 1244.60 minute cubic feet flowing over weir.

The horsepower of the minute cubic feet of water thus obtained for any head up to 50 feet given in power tables, pages 10 to 13, inclusive.

If water is measured by miner's inch method, give us the number of miner's inches of wate per minute, together with the head of water. We then will advise the horsepower that can be developed by our turbines.

Send us full measurements and particulars regarding proposed new turbine installment. We will reply promptly with full information.

Table Giving Minute Cubic Feet of Water 1 Inch Wide Flowing Over Weir

Inches Depth C Over Stake		⅛ Inch	¼ Inch	⅜ Inch	½ Inch	⅝ Inch	¾ Inch	⅞ Inch
1 Inch	.40	.47	.55	.65	.74	.83	.93	1.03
2 "	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3 "	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4 "	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5 "	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6 "	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7 "	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8 "	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9 "	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10 "	12.71	12.95	13.19	13.43	13.67	13.93	14.16	14.42
11 "	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12 "	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13 "	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14 "	21.09	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15 "	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16 "	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17 "	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18 "	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19 "	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20 "	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21 "	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22 "	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23 "	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24 "	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76

HYDRO-ELECTRIC POWER

FROM A

HOPPES HYDRO-ELECTRIC UNIT

A LOW COST SOURCE OF ELECTRICITY FOR FARMS, ESTATES, RANCHES, RESORTS, CLUBS, CAMPS, SMALL MANUFACTURING PLANTS, RURAL ELECTRIFICATION AND MANY OTHER USES.

In Addition to Hoppes Hydro-Electric Units The James Leffel and Company Manufacture a Most Complete Line of Hydraulic Turbines of All Sizes, Designs and Types for Low, Medium and High Head Installations. We Will Gladly Send Further Particulars on Such Turbines.

The Hoppes Hydro-Electric Unit has been specially designed to provide an economical source of electricity and power for people in locations where otherwise it would not be possible to enjoy it. This unit will give continuous service. It will operate without noise and require no further attention than for a small amount of lubrication.

This unit being of the efficient vertical design permits the generator and electrical equipment to be carried above flood water. This unit is direct connected. Troublesome and power absorbing gears and belts are eliminated.

The instrument board is equipped with voltmeter, switch. fused cutout, rheostat, and porcelain bushings to protect the wiring. The generator, instruments and governor are protected from the weather by a steel housing and the compact unit is furnished with an I beam foundation frame. A worm gear operated butterfly valve at the inlet permits shutting down the unit when desired. A tapered steel plate draft tube is furnished.

The turbine governor is mounted on the power shaft and regulates the speed of the unit. The generator is specially designed and the windings are carefuly treated to protect them from moisture. The rotor shaft is mounted on ball bearings. This sturdy unit offers the high grade of performance necessary for the sensitive electrical appliances, household and otherwise now available. These units can be furnished for either direct or alternating current.

Hoppes Units have been in continuous operation for over thirty years and have world wide distribution. They produce electricity at its lowest cost and make use of water in streams, which might otherwise be wasted. In most cases a small dam is required and the pond thus formed for power purposes can often be used also for watering stock, fire protection, recreation and many other purposes.

For nearly a century we have specialized in the designing and constructing of hydraulic turbines of all kinds. With this background of experience we are prepared to meet your requirements.

MANUFACTURED BY

THE JAMES LEFFEL & COMPANY

SPRINGFIELD, OHIO, U.S.A.

Established 1862